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PROCEEDINGS
of the
CONFERENCE
on
PEACH PROCESSING
and
UTILIZATION

Held at
Experiment (Griffin), Ga.

January 17 and 18, 1966

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

The Conference on Peach Processing and Utilization was held January 17 and 18, 1966, at the Stuckey Auditorium, Georgia Experiment Station, Experiment (Griffin), Ga. This conference was sponsored jointly by the Georgia Experiment Station; Georgia Cooperative Extension Service; Georgia Agricultural Commodity Commission for Peaches; Georgia Peach Council; Georgia Canners Association; Georgia Department of Industry and Trade; National Peach Council; Economic Development Administration, U. S. Department of Commerce; and the Southern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture. George H. King, Director of the Georgia Agricultural Experiment Station, Athens, Ga., served as General Chairman.

The purpose of the Conference was to acquaint representatives of the peach industry with current developments in research, production, marketing and utilization, and to provide for an exchange of information that will benefit the industry and future research.

These proceedings report the statements presented by the various speakers during the conference and give an account of the discussions following.

Underscored numbers in parentheses refer to references at the end of each paper. The data presented in the references are essentially used as it was supplied by the writer of each paper. The figures and tables are reproduced essentially as they were supplied by the author of each paper.

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PROCEEDINGS OF THE CONFERENCE ON PEACH PROCESSING AND UTILIZATION

Held at Experiment (Griffin), Ga., January 17 and 18, 1966

OPENING SESSION: G. H. King, Chairman

WELCOME

by

W. T. Fullilove
Director, Georgia Experiment Station,
Experiment

It is a pleasure to welcome this group to the Georgia Experiment Station. Some of you have come from long distances. We are mighty glad we have some sunshiny weather this morning after 2 or 3 days of rain.

We are fortunate indeed in being able to have this Peach Conference. We have secured splendid cooperation from a number of agencies. I will not go into that. I am sure that Dr. Woodroof will do that later.

We are very hopeful that all of this research and development work on peach products will lead to improvements in the peach situation. New products and processes should aid in the marketing system and make it more efficient. It should provide information to homemakers which will help them in family nutrition and management.

We are also hopeful that this research will aid farmers directly by expanding the markets for peaches and peach products. Some of it will lead to new industries; in fact, there already have been several new industries established. It will provide employment for many more people.

So, with these few remarks--I don't want to take up the time of the experts and there are several on the program--I will sign off, but not before letting you know that we are happy to have you here. If there is anything we can do to make your stay pleasant, we hope to do it. We also hope you will come back and visit us from time to time. Thank you very much.

INTRODUCTORY COMMENTS

by

G. H. King
Georgia Experiment Station, Experiment

I would like to pay my respects to the various committees. They have all done a wonderful job. Especially, I pay my respects to the Program Committee because seldom have I attended any conference that has such an array of talent on the program, all attacking one problem and that is peach processing and utilization.

Represented here are three departments of the Federal Government, I mean, Cabinet departments. The U.S. Department of Agriculture has several Divisions. There are eight land-grant universities represented here, in extension and research. We have the growers, processors, and all their allied industries represented. The bankers, I don't know why peach men would want bankers' help, but they are here. Consumers are represented by Miss Grace Hartley of the Atlanta Journal. Also represented are the two State Departments--our own State Department of Agriculture and our State Department of Industry and Trade. There is even a peanut commodity commission represented here in your banquet speaker tonight.

I don't think they have overlooked a thing. I think Dr. Woodroof and this Program Committee were thinking up some way of having a peanut-peach blend, and I am sure that Dr. Woodroof will come out with a peanut-peach blend and Pete Donaldson will sell it to the public.

Since I have gone with the Agricultural Commodity Commission for Cotton, I want our research workers working on a cotton container that will carry this peanut-peach blend.

Anyway, we have representation all the way from California to Florida, 13 States and the District of Columbia--all assembled on this one program. Now, with this array of talent, I don't see how the problem can keep from being solved.

You know, man's accomplishment to do is only bound by his imagination. We have a wonderful group of scientists, men who have shown their commercial astuteness by staying in the peach business either from the growing end or the processing end, and all of this scientific array of

knowledge will be focused on this one problem.

I would like to pay my respects to the Food Science Departments of the University of Georgia. We, in the University of Georgia, think that we are indeed fortunate to have two of the leading food scientists in the nation heading up our Food Science Departments here and at Athens. Dr. Woodroof as chairman of the division and head of the department is here, and Dr. John Powers is head of the department at Athens.

I think the public appreciates this. You will see, I am sure, before you leave here, the new food science building that is under erection now and will be dedicated on May 25. We are indebted to Governor Sanders for stimulating the building authority to put up the money along with some money he had, but we are also indebted to the peach growers themselves for taking on first Governor Vandiver and then Governor Sanders. I think they caught them right in a turn of office and finally held them up in a corner and got their promise of money.

You may look on your program and see the fine list of those that are sponsoring this Conference and thanks are due to all of them for their sponsorship. I do want to pick out three though at the risk of offending the others.

I would like to pay my particular tribute to the Economic Development Administration of the U. S. Department of Commerce and the Southern Utilization Research and Development Division of the U. S. Department of Agriculture who have, for the past several years, supported research work in utilization here. A contract has just been renewed for 3 more years which will enable this work to continue.

Other than that, I would like to pay tribute to the Agricultural Commodity Commission for Peaches, of which your own Edgar Duke is chairman. We have in this State eight commodity commissions, where the producers of a particular commodity can vote to assess themselves so much for promotion and research, and peaches happens to be one of them. Three of these commodity commissions are represented at this meeting.

The commodity commissions have gone a long way. They have been howling in the past but now they have banded themselves together and built it up, but they continue to howl. So if you have a getter-up and howler at the same time, you are going to see these commodities prosper in the years to come.

UTILIZATION RESEARCH IN SOUTHERN AGRICULTURE

by
B. H. Wojcik
Southern Utilization Research and Development Division

It is indeed a pleasure and a privilege for me to participate in this conference on "Peach Processing and Utilization." I am pleased because representatives from the Southern Utilization Research and Development Division (SURDD) have had the privilege of working with Dr. J. G. Woodroof, his associates, and the cosponsors in arranging the conference, and because Dr. V. H. McFarlane, Chief of our Food Crops Laboratory, has had the opportunity of working closely with the scientists at the Georgia Experiment Station in the development of new peach products.

It is unfortunate that Director C. H. Fisher of our Southern Utilization Research and Development Division, cannot be here today to meet with you and to deliver his remarks on "Utilization Research in Southern Agriculture." He had to remain in New Orleans this week for a meeting with an Advisory Committee on Utilization Research and Development. Dr. Fisher has asked me to convey to you his regrets for his absence and to extend his best wishes for a successful conference.

I have reviewed reports prepared by Dr. Fisher on utilization research in

agriculture, and if you will be so kind as to bear with me for a few minutes, I would like to cite a few excerpts from these reports.

Research and development is today a big and important function of business. Expenditures for research and development activities have grown rapidly in volume from $2.5 billion in 1950 to about $21 billion in 1965. Industrial and private organizations perform more than 70 percent of all research in the United States. The Federal Government pays for about 70 percent of the research. It is predicted that research and development expenditures will attain the $30 billion level by 1970.

Agriculture also is big and important. During his recent visit to New Orleans, the Secretary of Agriculture, Orville L. Freeman, paid tribute to the economic importance of American agriculture by saying that an immense complex provides equipment, fertilizers, consumer goods, etc., to the farmer at the rate of about $30 billion a year. To move the abundance of food and fiber to the consumer, a processing and manufacturing complex distributes more than $100 billion worth of consumer products annually. This means that total agriculture or "Agribusiness" is our biggest industry.

Agriculture and the processing of farm crops are particularly important in the South. The farm crops under investigation in our Regional Laboratory play a major role in the economic affairs of the Southern States. These include two important industrial commodities--cotton and naval stores (turpentine and rosin)--and several food crops.

Cotton is the most valuable crop in the group, with values of $2.5 billion and $18.5 billion, respectively, at the farm and retail levels. About 60 percent of our total effort is invested in cotton research. Cottonseed and citrus are worth almost $2 billion each at the retail level. Peanuts, naval stores, sweetpotatoes, cucumbers, rice, peaches, and other miscellaneous fruits and vegetables are included among the other crops under investigation in our laboratories. The total annual value of all these crops approaches $25 billion at the retail levels.

In broad terms, the utilization research of SURDD has the objective of enriching agriculture and our entire economy through the development of new, expanded, and/or improved uses of farm crops. New or improved products and processes increase the sales of farm crops and aid industry as well as the consumer.

The Southern Regional Research Laboratory in New Orleans is the headquarters of the Southern Utilization Research and Development Division. Its facilities include large pilot plants for chemical engineering and textile research. Four field laboratories in Florida, North Carolina, and Texas report to the Division Headquarters. In all, about 530 employees, of which approximately 55 percent are scientists, are engaged in carrying out the research and development activities of the Division.

In a recent study of the practical value of our developments, we attempted to estimate the contributions of our research to: (1) The Nation's economy; (2) the Rural Area Development; (3) the surplus and related problems; (4) national security; (5) consumer health and welfare; and (6) research and education.

It is not easy to measure the economic and practical benefits of research, but we have tried. Moreover, it is appropriate to point out that much of our research is done cooperatively with other organizations and that these organizations share some credit for many of our research successes.

What are the contributions of SURDD's utilization research to the Nation's economy as a whole? This can be answered in part by saying that about 100 developments stemming from our investigations have been applied to practice by industry.

It has been estimated that research on cotton by various organizations is responsible for the sale of 2.5 million bales of cotton, worth almost $3 billion a year at the retail levels.

The cumulative value at the consumer level of these and other commercialized developments, based principally on SURDD's research, is more than $18 billion. You may be interested to know that since its existence of almost 25 years, the Division has spent only $70 million on research. Thus, it can be said that each dollar spent on utilization research by our scientists has added $240 a year to the Nation's economy.

The inherent importance of the Division's developments to rural jobs and economy can

be illustrated by pointing out that total agriculture or agribusiness, provides a substantial proportion of the jobs in the United States. Most of these jobs are concerned with farm-related activities which, according to government statistics, account for the employment of 22 million people.

Utilization research has created new jobs and industries based on the processing and increased outlets of farm crops. Cotton is particularly pertinent for any consideration of rural area development because so many people are involved in growing cotton and producing finished cotton products. Market studies indicate that our contributions to the wash-wear development are responsible for the sale of 9 percent of the annual production of cotton and 13 percent of our yearly domestic consumption. On a proportional basis, one could conclude that about 1 million persons in cotton agriculture and industry have been aided economically by the wash-wear development.

Instant sweetpotato flakes, a new product, provides another example of how SURDD's research has retained or created jobs in small communities. About 150 new jobs have been created, not including those involved in related operations.

A new plant in a Georgia community recently initiated the manufacture of new peach products developed by Dr. Woodroof, his associates, and others is still another example of what utilization research contributes to the benefits of society.

The contributions of utilization research to the solution of surplus and related problems may be illustrated by studies conducted on cotton. The cotton surplus problem would have been more severe by about 2.5 million bales annually, except for utilization research. Because new or improved outlets for about 2.5 million bales of cotton were created, it has been estimated that the Department of Agriculture has saved approximately $100 million annually in subsidy, storage, and handling costs on this commodity alone.

In addition to the many benefits which our country derives from the research effort, the information developed is also being passed on to emerging Nations. This occurs not only from visits by their scientists to the various government laboratories but also from the many publications that are sent to such Nations upon their request.

Exports have been facilitated by the development of attractive processed food products at reasonable cost and the transformation of perishable crops into stable products of low weight and bulk. For example, 4 million gallons of frozen orange concentrate valued at more than $13 million are exported annually. This has aided the surplus problem and the dollar balance as well as enhanced the Nation's image abroad.

Approximately 18 significant contributions to the national security have been made by the SURDD in cooperation with groups involved in defense activities. They include such items as stretch cotton bandages, flame-resistant cotton products, water-repellent fabric, summer flight suits for the Navy, jet lubricants, synthetic rubber, various food products, and vegetable oil emulsions for intravenous nutrition.

Benefits derived from utilization research to consumer health and welfare are also difficult to assess. There can be little, if any, doubt that such developments as flame-resistant cottons, fire-retardant paints, peanut meal and extracts that aid hemophiliacs, convenience foods, and improved peach products, benefit the people of our Nation in protecting life and improving their health.

SURDD's research has produced vast quantities of new information about the composition, properties, and processing of farm products, and new analytical and research techniques including instruments that have been developed and described in the scientific literature. This valuable information, recorded in more than 3,000 publications issued by our scientists, is widely available for the use of universities, research institutes, agriculture, and industry. It is possible that the value of the new information, although indirect, exceeds the direct value of the new products and processes being used by industry.

Thus far, these remarks have been concerned with the research and development of the SURDD with headquarters in New Orleans. There isn't time to discuss the excellent agricultural utilization research done in the Northern, Western, and Eastern Utilization Research and Development Divisions located in Illinois, California, and Pennsylvania,

respectively. These Divisions also do research of value to the South. Techniques for the mass production of penicillin, methods for producing a blood plasma extender, improved technology for processing soybeans, and many instant fruit and vegetable products are examples of beneficial contributions to society arising from studies conducted at the laboratories of these Divisions.

You may be interested to know that the planning, as far as the building is concerned, for the fifth Utilization Research and Development Division to be located in Athens, Ga., is in the final stages.

The research and development program of the Southeastern Regional Research Laboratory will be concerned with the principal crops of the region and may include projects on poultry, eggs, meat, fruits and vegetables, forage crops, feeds, and oilseeds.

Information on the new Laboratory is contained in the report of the House Hearings for the Spring of 1965 and also in the report of the Senate Hearings for 1965.

The record shows that agricultural utilization research has paid tremendous dividends and that the benefits--both tangible and intangible--are so important that they defy description.

The future may be considered by quoting the last paragraph from a talk by Dr. G. W. Irving, Jr., Administrator of ARS:

> "And so, we continue to move ahead in utilization research ... continuously changing our patterns of work to reflect the needs and desires of the American people ... always keeping in mind our basic aim of converting imaginative ideas to tangible, economic processes and products. We are confident that our successes of the past will be multiplied, and that our opportunities for future success will be unlimited."

COMMENTS
by
E. H. Downs
Economic Development Administration
U. S. Department of Commerce, Athens, Ga.

It is nice to have the opportunity to meet with you people. Mr. Eugene Foley was invited to be down here, but previous commitments did not allow him to come.

The Department of Commerce was privileged to, as Dr. King says, in 1962 appropriate some $95,000 to help with the peach concentrate and specialized peaches. Last year we were able to get another $65,000 for 2 more years. I don't know what we are going to do with Dr. Woodroof, but every time I open my mouth, I have another request for another supplement. We now have a request for $13,000. Some of them kept me up last night wanting $35,000 more.

It is a pleasure to work with J. G. Woodroof, Edgar Duke, and Bill Wilson, and we are looking forward to more uses of our peaches. Our job in economic development is creating more jobs, and we feel we are having a part in that in the Southeast.

It is a pleasure to be here. Thank you very much for letting us help you sponsor the program.

FIRST SESSION

TRENDS IN PEACH PRODUCTION

Chairman, W. J. Wilson, Georgia Peach Commission, Fort Valley, Ga.

OPPORTUNITIES FOR GROWING PEACHES

by
E. F. Savage
Georgia Experiment Station, Experiment

Georgia rather romantically calls herself "The Peach State" and I believe rightfully so. It is true that we probably will never be first in total production. I think it would be most difficult to overtake the 27 million bushel lead that California has on us. However, Georgia built a vigorous peach industry early. In fact, we were shipping peaches by 1849. That industry was destroyed by the War Between the States, but we began again in the 1870's. The Elberta peach, Keystone or National Production, originated

in Georgia as have other famous varieties. Many modern production practices were initiated in this State. Actually, in spite of what some critics say, we deserve the name "Peach State." This name is an asset to Georgia. It creates an excellent public image. The mere mention of peaches stimulates pleasant thoughts. In the other 49 States and in Canada, peaches and Georgia are so closely associated, it is hard for people to think unkindly of this great State. By way of contrast, one of our sister States in the late 1930's and early 1940's called herself the "Iodine State." To many people this immediately brings up the anguish of sting-pain and the mental picture of huge goiters. For obvious reasons this cognomen was rapidly dropped. Even yet, though, when I ride on that State's highways, I always think "Iodine."

The Nation has come to expect good peaches from Georgia. This effect of good will that has been built up over the years is advertising of the highest type. It creates an opportunity for all Georgia peach growers. We have already sold the Nation with a vision of large, red, ripe, juicy Georgia peaches, and now we have to live up to this opportunity.

Another of our golden opportunities or advantages is that we have more than adequate transportation. Our interstate highway system to the northeast is complete nearly to the Canadian Border. It provides facilities for rapid truck transportation to the populous areas of the Northeast. Therefore, we can pick fruit riper, and that means greater size and higher quality. We can have this fruit on the market 24 hours after it is picked.

Atlanta has one of the finest airports in the United States. The time is coming when we will ship our highest quality fruit by plane so that there can be conceivably no more than an 8-hour lapse between picking and the time the fruit is in the hand of consumers. This is already being done in the case of strawberries from California. This will be a high-priced item for discriminating consumers. It may not move much volume, but it will make considerable money change hands.

Times are changing though. We expect fresh fruit in the years ahead to become more and more of a luxury item. Today's housewife has no time for long, tedious hours spent in food preparation. Not only that, she does not have the inclination to do this work. I heard a speaker say recently that the American wife is not only beautiful, intelligent, and witty, but also is excessively lazy. There is another side to this story. This same wife usually is working 8 hours a day to help pay for a $30,000 home, a color television, and an expensive automobile. There is no domestic labor available, so she turns to processed products. Though not as good, they are quicker. Besides, what modern youngster or young husband has had an opportunity to develop discerning food tastes? Food is food, and that is that.

Thus we can expect large volume of peaches to be processed in the future. Many new products in addition to the usual canned and frozen peaches and peach pickle will be produced. A start was made this year in a commercial way on production of a peach-puree base which may be converted to a peach-juice drink. Some three thousand 55-gallon drums of this excellent product were produced this year. It will need promotion, but it should sell.

Refrigerated peach slices offer a great opportunity to utilize a considerable tonnage of fruit. The Pipping Packing Corporation of Winter Haven, Fla., put up some 10,000 cases of refrigerated peach slices in 1964. These really sold. At the height of the fresh-peach season in Kentucky, one test-sales store was selling approximately 500 cases of this product per week. This year this company produced 100,000 cases. The shelf life of this product is theoretically 8 to 12 weeks. No commercial test of shelf life is available since this company sold its entire pack long before this time had elapsed. It is a beautiful product. Is it possible that opportunity is hammering on some Georgia processor's door? This company hauled these peaches from as far away as Michigan and New Jersey. If they can do that, I would think some processing plant in the peach production area could function more efficiently. Incidentally, this company obtained its processing procedures from Kell Heaton of this Experiment Station. There is room for much expansion in the production of refrigerated peach slices. If this product was available, it would be used widely by restaurants. The busy housewife could rush from her bridge game to her favorite grocery store, pick up a jar of these refrigerated peaches, a can of squirt cream,

a package of short cakes, and have a dessert ready in 5 minutes after her arrival home. These are but two products that could utilize thousands of bushels of peaches. Any alert food processing department will come up with many more products in the years ahead. The trend is toward processing.

What are the changes in peach production in the Southeast? These changes in themselves spell opportunity. In 1926 we had 16 million trees in Georgia. This was the high point in our peach-tree population. In 1940 we stood at a little over 8 million trees; in 1952 we hit a low of 2,800,000 trees; by 1957 the population upped to 4,300,000; in 1961, 3,900,000; and in 1965 the survey of K. E. Ford and his associates of the Agricultural Economics Department show only 2,633,000 trees. This is a preliminary figure, with one more farm to report. South Carolina's trends are downward, too, at the present time. In 1950 South Carolina had a total tree population of 4,375,000; in 1958, 4,927,000; in 1964, 3,888,393; and in 1965, 3,730,913 peach trees. The two States together now total only 6,363,913 trees.

Certainly with a greatly increasing population and an expanding economy, together with dwindling food reserves, the production of this number of trees could be utilized by both the fresh-fruit and processing industries. Could it be that there is a wide-open opportunity for peach promotion on a national basis indicated? Do we need a National Organization to push and advertise fresh peaches and processed peach products? I will let you be the judge. This very low peach-tree population plus adequate promotion in a time of expanding population and decreasing food supplies cannot mean anything but opportunity for peach growers.

It should be pointed out that of the 2,633,000 total tree population in Georgia only 353,000 trees, or 13.4 percent, are of nonbearing age. These are an insufficient number of trees to maintain even our present production. Might that not be opportunity?

What is the variety picture in Georgia? The top ten peaches presently in bearing orchards are as follows:

Varieties in Bearing Orchards--Georgia

Variety	Number of Trees
1. Coronet	242,000
2. Keystone	208,000
3. Maygold	203,000
4. Elberta	196,000
5. Sullivan	163,000
6. Southland	157,000
7. Redcap	145,000
8. Cardinal	135,000
9. Loring	95,000
10. Redskin	82,000

Coronet is the top variety in bearing orchards, with Keystone second, and Maygold third. The Elberta-type peaches total 359,000 and are utilized primarily in processing. Southland is still in there in goodly numbers. It is interesting to note the number of Redcap and Cardinal currently in production. Several years ago Hiland and Dixired were far ahead of these two varieties in numbers of trees. It is remarkable how many of these have been pushed up in the last 2 years.

As to the varities in nonbearing orchards, Maygold and Suwanee which were especially designed for the South Georgia peach section make up 93,000 trees, or 26.4 percent. The greater part of these two varieties are planted in the South Georgia peach section.

Varieties in Nonbearing Orchards--Georgia

Variety	Number of Trees
1. Maygold	57,000
2. Suwanee	36,000
3. Elberta	29,000
4. Loring	28,000
5. Blake	23,000
6. Dixiland	23,000
7. Redglobe	21,000
8. Redskin	14,000
9. Redcap	13,000
10. Cardinal	12,000

Of the very early varieties, Redcap and Cardinal are being planted. These are the survivors of the early season peaches. I am possibly a little surprised at this, since

Dixired is by far the better variety. However, because of its high cold requirement, Dixired is primarily adapted to the North Georgia peach section and this area has lost money on early peaches, it is not difficult to understand. The early clingstone demand has already been saturated by the time the peaches in this area comes into production. Cardinal apparently does better in the Central Georgia peach area because of the lower cold requirement. Loring and Redglobe are the replacement midseason peaches. Dixiland, Blake, and Redskin are the high colored varieties that hopefully will get under the wire before the market is depressed by heavy Elberta shipments. Elberta is being planted in the North Georgia area as a canning peach. The new plantings of Coronet and Keystone are very low--3,000 and 10,000 trees, respectively. The picture is before you. It means opportunity for the Central Georgia peach area.

We can take a more optimistic viewpoint now towards our production problems than we have been able to do in the last decade. The most important production problem we have is the short life of peach trees, and this is followed by the problem of labor shortage.

Take first the short life of peach trees. There are many things that can trigger the death of peach trees. Pathologists in New Jersey say it is cytospora canker; Georgia pathologists claim it to be pythium; in South Carolina bacterial canker is the vogue of the day. The nematologists feel that it is bound to be nematodes. The plant physiologists really can drag up some good explanations. What a man sees, unless he has had wide experience, is dependent on his training. It is all according to the kind of glasses he wears. These maladies are the things that weaken trees, but generally they cannot by themselves kill trees--at least not by the thousands. It is pure and simple cold that finishes them off--cold which occurs in the late winter when the rest period has been satisfied and the tree is physiologically active. It is practical and feasible to alter the microclimate around the trunks of trees, especially in the South Georgia peach section where cold waves are of short duration. By lengthening tree life beyond the average of 8 years an opportunity is provided for peach growers to economically survive.

By subsoiling an orchard along the tree row previous to planting an orchard, we can double the rate of tree growth and essentially double production. This is true in the Piedmont clays and in the Coastal Plain areas. All we are doing is to make possible more rapid root growth during the critical period of the tree's first year in the orchard. Subsoiling an established orchard is a dangerous practice in that you destroy roots and hasten the drying of the soil.

Cultivation with disc harrows will shortly become an obsolete practice. Weedicides along the tree row and mowing in the middles will be the new method. This, too, has a tendency to increase growth and production. The need of heavy equipment is decreased, and this method required a less skilled operator. Fewer trees will be mutilated.

Bulk handling of peaches will eliminate a large labor requirement. It is already with us.

That leaves only thinning and harvesting for which to find really adequate methods of reducing labor.

These newer production methods give the grower an opportunity to use less labor and reduce production costs. All peach producers are working towards this end. It is a result of our times of "Less Work for More Pay." It is also harder to find the "Stoop and Reach Labor" that agriculture requires.

The numbers are dwindling both in tree population and growers. Our population is increasing, the economy expanding, and our food supplies decreasing. This should bring about a greater financial reward for those that are left. It will be necessary to be most alert to change if we are to survive. It will be advantageous to bend every effort to promote peaches and peach products. We will have to align ourselves with national organizations and provide them with the necessary money to operate efficiently in the promotion of peaches. They cannot work miracles with a few hundred dollars for advertising. The opportunities for peach growing in 1966 in the Southeast are greater than they have been in the past 15 years. When everybody is getting out, it is the time to be setting trees.

DEVELOPMENTS IN PEACH BREEDING

by
V. E. Prince
Crops Research Division, USDA
Fort Valley, Ga.

(No copy of this paper is available for publication.)

GROWING PEACHES FOR CANNERS (SUMMARY)

by
J. D. Walker
Peach Grower, McDonough, Ga.

I like to grow peaches and have grown them, along with cotton, for 12 years. I have observed that those who grow other crops along with peaches get along better than those who grow peaches alone. This is especially true in years when the peach crop is short.

Growing peaches for canners has several advantages:

1. The fieldmen representing the cannery are well posted on peach growing and the peach industry in general. These men are interested in the crop and want to help you.

2. Growing peaches for the cannery allows the fruit from 24 to 48 hours more time on the trees. This is a crucial time, allowing the peaches to increase in size, sugar, and color.

3. When growing peaches for the cannery we do not prune or thin quite so close.

4. When growing peaches for canning, we do not have to spray with certain chemicals, such as captan, for additional color.

5. We deal directly with the fieldmen representing the cannery and know exactly what we are getting for our peaches.

6. A visit by the fieldmen at picking time is a great help in advising us when and how to harvest the peaches for canning. He makes us feel like "my peaches are his peaches."

Other than the above, I would say that growing canning peaches means just growing peaches. That is, it eliminates the necessity for building a packing shed, buying containers, and marketing the peaches. However, peaches for the cannery require the same care in spraying, insect and disease control, and spray residue. Since the peaches for canning are a little riper, a little more care is required in harvesting to avoid bruising.

The canneries do not like small peaches, nor split-seeded peaches. We try to eliminate these before they get ripe, either by shaking the trees or picking the fruit off by hand.

The same care in proper cultivation, fertilizing, and handling other orchard problems are the same. One of the biggest points of controversy between the peach grower and the cannery is that the grower frequently would like to deliver peaches that are unsuitable for canning in the first place. The grower should realize that the canning industry must maintain good quality. This can be obtained only by the grower delivering good quality peaches to the cannery.

MECHANICAL HARVESTING OF PEACHES

by
S. L. Hedden
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Lake Alfred, Fla.

(Mr. Hedden presented a color film and commentary on methods of mechanically harvesting peaches. No copy of the commentary is available for publication.)

SECOND SESSION

STORAGE, PROCESSING, AND MARKETING OF PEACHES

Chairman, J. G. Woodroof, Georgia Experiment Station, Experiment, Ga.

ECONOMICS OF PEACH GROWING

by
K. E. Ford
Georgia Experiment Station, Experiment

The peach industry is an important segment of the agricultural economy of Georgia and is the major source of agricultural income in several counties in the State.

The main purpose of this paper is to discuss some of the practices or operations in the growing of peaches in which there are possibilities for more economical production or cost reduction. Due to time limitations, generalities and averages are necessary with a limited number of examples or illustrations.

A few years ago, data were obtained from peach growers in the State through the survey method by members of the staff of this Station relative to their practices and costs in producing peaches. This information was released in the publication series.[1,2/]

Use will be made of physical inputs rather than dollars and cents in this discussion today to eliminate the necessity of a discussion of wage rates and charges for materials, tractor use, equipment use, and so forth, which vary from year to year and area to area. The use of physical inputs for an operation or practice permits comparisons which would not be possible when dollars are used as the basis for costs.

Pertinent questions commonly asked are: "Where can costs be reduced in the production of peaches? For what practices is it possible to reduce costs?"

The point of beginning should be to explore the operations requiring the greater number of units of inputs or the more costly inputs. Labor requirements averaged 124.7 man-hours per acre and amounted to more than one-half all direct dollar costs to produce early peaches in the Fort Valley area in 1960 (table 1). This is an average for 7 years of production, from the third "green" through the ninth "green." Certain practices--cultivating and fertilizing--had very little variation in costs associated with age of the trees. Trees 3-, 7-, and 8-year-old were cultivated the same number of times at almost identical costs per acre.

Among the least costly operations in terms of both input requirements and total

1/ Ford, K. E. Peach Production Practices and Costs in South Georgia, 1960. Georgia Experiment Station, Experiment, Ga. Mimeo. Series N.S. 153. September 1962.

2/ Ford, K. E. Peach Production Practices and Costs in North Georgia, 1960. Georgia Experiment Station, Experiment, Ga. Mimeo. Series N.S. 156. October 1962.

Table 1. --Average inputs and costs per acre to produce early peaches in the Fort Valley area, 1960

Operation	Times over	Man-hour labor	Tractor use	Equipment use	Total cost
	Number	Hours	Hours	Hours	Dollars
Pruning	1.0	10.4	-	-	7.78
Removing limbs	1.0	4.8	0.7	0.7	3.72
Cultivating	6.6	4.5	4.5	4.5	11.63
Fertilizing	1.0	1.8	0.3	0.3	10.98
Thinning	1.0	26.5	-	-	10.62
Spraying	9.9	8.1	3.5	3.5	23.91
Harvesting	4.1	68.6	7.7	5.7	43.01
Total	24.6	124.7	16.7	14.7	111.65

costs--removing limbs, cultivating, and fertilizing--only slight economies are possible. It will be almost impossible to reduce costs for these operations, and the peach grower should not devote much time to them except to see that the jobs are well done. There have been changes in some of these operations over the past 20 years which have reduced the input requirements almost as much as they can be reduced without development of new technology; that is, at one time the limbs were hauled from the orchard and burned. They are shredded and turned under at the present time.

Turning to operations with the greater number of units of inputs required or the higher costs of operation, thinning ranks second in the number of man-hours required per acre. The thinning practice in the Fort Valley area involves removal of immature peaches before the kernels are hard. This is a hand operation and, depending upon the set, a large number of man-hours is required to do the job properly. Evidently, the wage rate for this operation was among the lowest; however, mechanical or chemical thinning may be operational in the future, especially if wage rates increase or the supply of labor decreases.

Spraying ranks second in total costs among the various operations in peach production. Cost of materials was the crucial factor in this operation. About the only possible economy would be to reduce the number of applications or use less expensive materials, either of which could be false economy in that the quality of peaches could be lowered.

Harvesting was the most expensive operation in 1960. This operation required the greatest number of man-hours of labor in the production of peaches. More than one-half the total man-hours of labor used was required in the harvesting operation. Any percentage reduction in labor inputs in this operation will result in a greater saving than the same percentage reduction for any other operation unless there is a greater difference in the wage rate for the various operations.

Mechanical devices for the removal of the fruit from the tree are in the experimental stage. However, picking or the actual removal of the fruit from the tree continues to be a hand operation. The usual practice is to pay the worker by the bucket or bag, and the greatest problem is that of supply of reliable labor.

Ways and means to reduce the man-hours of labor for other phases of the harvest operation have been or are being initiated. Most of this labor is paid by the hour, and any reduction in the number of laborers required or more efficient use of the labor will result in greater economies. Either palletizing the load of bushel field boxes in the orchard as the wagons are loaded or the use of pallet bins are being adopted. The practice of scattering field boxes along an alley in the orchard before picking and loading them on the wagons after filling is practiced by only a few growers at present.

Palletizing the load of bushel field boxes in the orchard is accomplished by having 24 empty field boxes placed on a pallet at the

packing shed. Two empty pallets are placed on the front end of the field wagon, and pallets of empty boxes are placed on the remainder of the wagon. The wagon is moved along the alley in the orchard, and pickers bring their picking buckets to the wagon. A man on the wagon dumps the peaches into the field boxes which are on the pallet. This method of operation eliminates the necessity of distributing empty field boxes from the ground (the picker does this when he brings the bucket to the wagon), and the person on the wagon can observe the condition of the peaches as they are dumped. Also, utilization of the field boxes is increased during the harvest, and boxes are not left in the orchard after the harvest is complete. Fork lifts are used in the transfer of the pallets from wagon to truck and from truck to packing shed floor.

Pallet bins were used this past season for the first time in the harvesting of Georgia peaches. Fork lifts were used in the transfer of both empty and filled bins. These bins had a maximum capacity of 20 bushels and were built on pallets. Empty bins were placed on wagons which were moved along the alley in the orchard. The pickers lifted filled buckets to a man on the wagon to be dumped into the bins. He inspected the quality (maturity) as he dumped the peaches. Bruising of the peaches could be reduced through the use of the pallet bin. The buckets were placed in the bin to pour the peaches which did not have as great a distance to fall as when they are poured into field boxes.

Economies in the harvest operation through the use of pallet bins were accomplished in two ways. First, the number of laborers needed was reduced both in the orchard and in the packing shed. Fork lifts and automatic dumpers were substituted for men. Secondly, the investment is less and the utilization greater for pallet bins than for field boxes. A 20-bushel bin costs about one-half that of 20-bushel field boxes. Moreover, it is less likely to be damaged or lost and it can be sent to the orchard more times during the season.

In conclusion, over one-half the dollar input for the production of peaches is labor. Economies in this area are of major importance. Operations such as removal of limbs and cultivating use relatively little labor, and potential savings are small. Labor is the major expense in thinning; but until mechanical or chemical means of assisting in thinning are developed, little can be done here. In harvesting labor is also a major expense, but much can be done to reduce costs while producing a higher quality product.

RIPENING PEACHES FOR CANNING

by
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Georgia Experiment Station, Experiment

The appearance and market quality of the canned peaches depend considerably on the extent to which the halves retain their firmness, color, and shape, through processing and subsequent handling.

Because the freestone, a melting flesh type peach, is the only one canned in the Southeast, a study was made to determine the effects of three stages of ripeness (firm, fully, soft) on the physical, chemical, and sensory values of Southland, Redglobe, Sullivan Elberta, and Elberta peach varieties. These varieties ripened at approximately 1-week intervals from one another, in the order named and varied in characteristics including appearance, color, texture, and flavor.

Culpepper and Magoon (2) showed that the pressure test was a dependable criterion for comparing varieties of sweet corn in regard to their physical texture and suitability for canning purposes, as well as for determining the stage of maturity in the individual variety. Culpepper and Caldwell (1) using this method showed that the pressure penetrations of most peach varieties were very uniform over all parts of the fruit, 6 to 10 days prior to reaching the shipping stage of ripeness. As ripening proceeded, the resistance to pressure decreased uniformly over the whole surface; but when the shipping ripe stage was reached, the rate of softening in different areas became unequal. As the stage of maturity increased before canning, the firmness

of the raw and canned fruit were more nearly the same.

The purpose of this study was to evaluate the quality of canned peaches, processed from fruit ripened on the trees to three stages of ripeness, firm, fully, and soft.

Procedure. --The peaches were ripened on the trees and harvested from blocks of 10 to 20 normally loaded, healthy trees. It was trucked from the commercial orchards to the Food Science Department for this study, then graded to obtain the same degree of maturity, as closely as possible, on the basis of skin color.

Firmness. --Ten peaches, which were typical of the whole sample in size, color, and stage of ripeness, were used to determine the firmness of the fruit before processing. A Chatillon Gauge R pressure tester, calibrated to read from 0 to 10 pounds of pressure, employing a plunger 5/16th of an inch in diameter and 5/16th of an inch penetration, was used for this study. Four tests were made on each peach, at approximately equal distances around the periphery and the fifth at the tip end. The skin was removed from each part of the peach where the tests were to be made. Fifty readings were averaged to determine the firmness of the fruit. The three stages of maturity used in this study were firm, fully ripe, and soft ripe, with pressure readings from 9.4 to 3.3 lb. (for firm ripe), 4.1 to 1.8 lb. (for fully ripe), and 1.0 to 0.6 lb. (for soft ripe). The ten peaches used for the pressure test were peeled, pitted, and blended into a puree, and then used for the chemical determinations.

For measurement of canned peaches, two halves from each can were punctured with the Chatillon tester, employing a 3/16th of an inch plunger and 5/16th of an inch penetration, calibrated to read from 0 to 500 g. The average of the 10 readings was taken as the firmness of the canned halves.

Soluble solids. --This was determined on fresh and canned fruit. A sample of the puree was pressed through cloth, the juice then read on a Bausch and Lomb refractometer as percent soluble solids.

pH. --A sample of 50 ml. of puree was used to determine the pH by using a Beckman Zeromatic pH Meter.

Total titratable acidity. --Ten grams of puree were added to 490 ml. of distilled water, then titrated with 0.1 N NaOH to the pH of 8.2

Processing. --The graded fruit was peeled by dipping or submerging it in 5 percent lye at 215° F. for 30 to 60 seconds, exposed for the same length of time, and washed in jets of cold water to remove the peels and excess lye. The fruit was pitted with a mechanical pitter, and the halves were graded, filled (19.5 oz.) into a No. 2-1/2 can, and covered with hot (210° F.) 40 percent sucrose syrup (12 oz.). The filled cans were exhausted in a water bath to a center temperature of 160° F. and sealed. They were processed for 25 minutes in boiling water, then cooled to 100° F. in a spray of water, dried, cased, and stored at 70° F. for 5 months before further evaluations.

Evaluation of the canned peaches included, U.S. Grade, drained weight, Hunter Color, firmness, and sensory values, which were made on the halves from five cans of each experimental sample. The syrup from each can was used for viscosity, turbidity, pH, total titratable acidity, and soluble solid determination.

U.S. grade and drained weight. --The official method of U.S. Standards for Grades of Canned Freestone Peaches, Third Issue, was used for grade and drained-weight evaluations. The halves were compared against a USDA Peach Color Guide F-1 (Part No. 13961) plastic half, in the Macbeth Examolite Daylight 7400° K Model EBA 220 box to determine the grade color.

Hunter color. --Two halves from each can were used to measure the color with a Hunter Color Difference Meter. The Ivory Standard (L 73.8, a_L + 1.4, b_L + 31.4) with the 1-inch orifice and light setting at "L" was used for this measurement.

Sensory values. --Two to four halves from each can were saved for the following sensory evaluation, appearance, aroma, color, texture, and flavor, by a 10-member panel, using 10 as excellent and 1 below fair.

Chemical evaluations were made on the syrup from each can.

Viscosity. --250 ml. of syrup was used to determine viscosity with the Brookfield Synchro-Lectric Viscometer and a No. 2 spindle.

Turbidity. --50 ml. of syrup was strained through a 20-mesh screen to remove the large particles from the syrup. A Spectrometer 20, set at 475 mμ, was used to measure the optical density of the syrup before and after centrifuging for 10 minutes at 2,000 r. p. m.

Total Phenols and Leucoanthocyanins. --This was made according to the procedure of Swain and Hillis (3) using Folin-Denis and Butanol-HCl reagent, respectively.

Results and Discussion. --Peaches for processing may be ripened by two methods: (1) On the tree, at orchard conditions, and (2) controlled environment. Studies were made using both methods, but this report deals with ripening on the tree. Because this type of ripening is used by most processors in this section, they have no control over the quantity of fruit available at any one time. If fruit is harvested at the optimum maturity, a state when the green color characteristics of immature peaches changes to a straw yellow, such fruit may vary in firmness between varieties as shown in table 1. The Southland variety, at the straw yellow stage, had an average pressure test reading of 1,506 g., Redglobe 4,282 g., Sullivan Elberta 2,728 g., and Elberta 4,196 g. When the fruit is processed, this wide spread in firmness was not present in the canned halves, as shown by reading of 311 g., 310 g., 301 g., and 324 g., respectively, for the four varieties. As ripeness progressed from firm to fully ripe stage, the canned halves of the Southland variety became less firm than the other varieties studied. This loss in firmness, as ripening progressed to the soft stage, was a factor in the reduction of U. S. Grade for the four varieties. The USDA Grade and drained weight, shown in table 2, decreased as maturity increased. The Redglobe variety was graded the highest 92.2, 91.0, 84.0; Elberta 88.8, 87.2, 79.2; Sullivan Elberta 89.2, 81.4, 78.0; and Southland 90.6, 83.2, and 72.6, respectively, for the three stages of ripeness.

The results of the sensory values are shown in table 2. The flavor of the canned halves was not significantly affected by the degree of ripeness before canning, except for the Southland which obtained its maximum flavor at the fully ripe stage. But there was a difference between the varieties--Redglobe had the highest flavor score of 7.6, followed by Southland 6.8, Elberta 6.7, and Sullivan Elberta 5.6. These differences may be associated with the total tannins 92, 92, 118, and 128 mg./100 g. fresh weight, respectively.

The color ratings were the highest for Redglobe 7.4, followed by Southland 7.2, Elberta 6.6, and Sullivan Elberta 6.4. These differences may be associated with the leucoanthocyanins 25, 34, 77, and 58 mg./100 g. fresh weight, respectively.

The appearance and texture ratings decreased as the ripening of the fruit before canning progressed. The Southland variety softens very rapidly after harvest and becomes ragged after processing. This characteristic of this variety makes it very hard to ripen properly for processing. The study also showed that Redglobe will process at any stage of ripeness without appreciably affecting the quality of canned halves.

The results of the chemical evaluations are shown in table 2.

The soluble solids of the raw fruit increased with advance maturity, but this was not always reflected in the cut-out soluble solids of the canned fruit.

The total titratable acidity of the raw fruit for Southland and Sullivan Elberta varieties increased with the development of maturity, Elberta decreased, and Redglobe remained practically unchanged. There was a decrease in total titratable acidity for all four varieties with maturity. The turbidity of the syrup was higher with the increase in ripeness, which is associated with raggedness of the canned halves. The Redglobe variety was the least turbid and less ragged of the four varieties for all three stages of ripeness.

The viscosity of the syrup decreased as ripening increased for all varieties, but the Redglobe variety had the highest and retained the highest for all three stages.

Table 1.--Effect of three stages of maturity on the sensory values and U. S. Grades of canned Southland, Redglobe, Sullivan Elberta, and Elberta varieties of peaches

Peaches	U.S. Grade Total Score	Drained Weight	Sensory Scores 1/ Appearance	Aroma	Color	Texture	Flavor	Total	Comments
		G	10	10	10	10	10	50	
Southland:									
Firm	90.6	515.2	7.00	7.10	7.20	7.00	6.65	34.95	Sl. dull, hard texture, lacking flavor.
Fully	83.2	487.6	6.40	7.25	7.70	6.80	7.40	35.55	Sl. ragged, tender, delicate flavor.
Soft	72.6	442.0	5.20	7.20	6.60	5.40	6.40	30.80	Ragged, soft, fibrous, ripe peach flavor.
Redglobe:									
Firm	92.2	548.8	7.90	7.50	7.70	7.90	7.55	38.55	Bright, smooth, texture firm, sl. tart flavor.
Fully	91.0	510.4	7.40	7.40	7.55	7.80	7.70	37.85	Bright, smooth, tender, excellent flavor.
Soft	84.0	501.0	6.60	7.30	6.85	7.30	7.40	35.45	Sl. ragged, sl. oxidized color, soft, sl. over ripe, bitter.
Sullivan Elberta:									
Firm	89.2	491.2	7.10	6.50	6.10	6.40	5.60	31.70	Sl. green appearance, tough outershell, sl. green bitter flavor.
Fully	81.4	477.2	5.80	6.95	6.30	6.00	5.60	30.65	Ragged, soft, stringy, sl. oxidized.
Soft	78.0	448.8	5.10	6.50	6.90	5.70	5.70	29.80	Very ragged, soft, stringy, bitter and metallic flavor.
Elberta:									
Firm	88.8	528.8	7.25	7.35	6.80	7.10	6.85	35.35	Sl. ragged at cavity, tough texture, tart flavor.
Fully	87.8	501.6	6.60	6.80	6.90	6.40	6.60	33.30	Sl. oxidized, sl. tough, tart, sl. green.
Soft	79.2	467.0	5.00	6.90	6.00	5.30	6.60	29.80	Ragged, stringy, oxidized flavor.

1/ These were scored from 10 (excellent) to 1 (below fair).

The Hunter Color "a" and a/b ratio were higher as ripening increased, indicating a buildup of the red color components.

Summary.--The stage of ripeness influences the grade, chemical, and sensory values of the canned halves of Southland, Redglobe, Sullivan Elberta, and Elberta peaches. This study showed that with an advance in ripeness, some factors increased while others decreased almost in proportion to the degree of ripeness, also that some varieties soften more rapidly after harvest than others.

Factors that increased with maturity were soluble solids, acidity, red color components, turbidity, and fragmentation; those which decreased included firmness of the raw and canned fruit, percent drained weight, viscosity of syrup, appearance, color, texture, flavor, and U. S. Grade of the canned peach halves.

From these results, peaches for canning should have UNIFORMITY--of size, color, texture, and flavor. These can be obtained by variety and ripeness.

Size and shape can be controlled by cultural practices, the most desirable size should produce a count of 10 to 12 halves per No. 2-1/2 can, 2 to 2-1/2 inches in diameter. They should have small seed and free easily,

Table 2.--Effect of three stages of maturity on the physical and chemical values of canned Southland, Redglobe, Sullivan Elberta, and Elberta varieties of peaches

Peaches	Pressure test		Soluble solids		Fruit : Syrup		Total acidity as acetic		Viscosity	Hunter Color			Turbidity
							Fruit : Syrup						
	Raw	Canned	Raw	Canned	Raw	Canned	Raw	Canned	Syrup	a	b	a/b	
Southland:	G.	G.	Pct.	Pct.			Pct.	Pct.	C.p.s.				O.d.
Firm	1,506	310.5	9.4	21.98	4.00	3.94	0.5080	0.4263	122.2	0.85	25.80	0.0329	0.0961
Fully	939	172.5	9.4	22.06	4.00	3.85	.5140	.3719	78.5	4.73	26.49	.1786	.2069
Soft	416	122.5	9.6	22.74	3.90	3.85	.5580	.3241	54.9	5.43	25.16	.2158	.3866
Redglobe:													
Firm	4,282	310.0	9.6	21.84	4.00	3.71	.4880	.4004	177.8	1.61	27.45	.0587	.0424
Fully	1,211	234.5	9.8	22.56	3.90	3.71	.4800	.3732	125.4	3.90	28.11	.1387	.0641
Soft	472	190.5	10.6	22.40	3.95	3.70	.4970	.3861	101.8	4.97	26.68	.1863	.1738
Sullivan Elberta:													
Firm	2,728	301.0	9.5	20.82	3.95	3.70	.4330	.3919	93.7	1.63	29.18	.0559	.1110
Fully	835	216.0	10.2	20.14	3.95	3.75	.5090	.3648	60.6	5.36	30.04	.1784	.2367
Soft	399	187.0	10.4	20.72	4.00	3.75	.5280	.3544	51.9	5.71	29.14	.1960	.2793
Elberta:													
Firm	4,196	324.0	10.1	21.30	3.70	3.60	.6380	.3958	107.1	2.16	26.88	.0804	.0752
Fully	2,064	296.5	10.6	21.58	3.80	3.55	.5330	.3881	93.2	4.33	26.95	.1607	.1666
Soft	254	209.5	10.4	20.90	3.85	3.64	.5280	.3687	72.2	8.83	27.55	.3205	.2892

and remain whole after processing, retaining a symmetrical form. The halves in each can should be smooth or ragged, not mixed, this can be obtained by firm or fully ripe Redglobe for smooth halves, or Elberta fully or soft ripe for ragged halves.

Color should be uniform, This factor lowers most canned freestone peaches several grades. The color can range from yellow to orange-yellow but again must not be mixed within the cans. The halves should be free of blemishes, remove all peels, discard frog-eye infected peaches. They should be resistant to browning or darkening during or subsequent to processing. Use Halehaven, Redglobe, or Dixiland for example, not Sullivan Elberta or the like.

Texture. --The peaches should be resistant to bruising during handling, but cook to a uniform tender texture, free of excess fibers. Flavor should be balanced in sugar, peach, and acidity; this is obtained by ripeness, variety, and syrup concentration.

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APPENDIX
Steps in Canning Peaches

1. Receiving and grading. Unripe fruit may be held in field containers for further ripening.

2. Dumping field boxes onto belt or pallet boxes into tank of water. Water absorbs the shock and washes the fruit.

3. Grading and sizing on rollers.

4. Pitting by machine or hand.

5. Regrading, removing pits, and turning the peach halves with peel up.

6. Lye peeling by spraying or immersing, followed by brief holding to allow lye to react with peel.

7. Washing with spray or in rotary washer, and turning the halves with seed side up.

8. Rewashing with spray or vibrator washer.

9. Grading and inspecting.

10. Sizing into three grades.

11. Adding 4 ounces of 65° Brix syrup at 200° F.

12. Adding 19 ounces of fruit per can.

13. Adding 8 ounces hot water, or enough to fill can.

14. Sealing under vacuum.

15. Cooking cans in continuous cooker or in retorts at 212° F. for 45 minutes, or to an internal temperature of 190° F.

16. Cooling to 90° to 100° F. in countercurrent water.

17. Labeling and casing.

18. Warehousing and shipping.

RESEARCH NEEDED TO EVALUATE COSTS AND EFFICIENCY IN PEACH PROCESSING

by
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Peach production for fresh market has long been centered in the Southeast, with Georgia and South Carolina as the States leading in peach production for fresh market. In my opinion, it is wise that peach industry leaders and agricultural research leaders are examining processing as a market outlet for peaches and other fruits and vegetables grown in the South. It is good, too, that you are interested in costs and efficiency in processing peaches.

In the short time available, let me describe some research under way in the region which bears directly on my topic. You may be interested in the development of this research.

In 1958 under the sponsorship of the Farm Foundation, the Heads of the Departments of Agricultural Economics met to evaluate the marketing research program in the Southern region. These Department Heads promptly recommended to the Directors of the Agricultural Experiment Stations in the South that they establish a Southern Marketing Research Committee "to develop ideas and suggestions that will be of maximum use to the research program of the future." These were laudable goals, and the Committee worked hard in defining their task and agreeing on how to go about it. Dr. J. C. Purcell of the Georgia Experiment Station has been a member of this Southern Marketing Research Committee and could give you a more detailed account of the work of the Committee.

In August 1963 the Committee published its second report, A Framework for Marketing Research in the South. I think this report is worthy of your attention. A summary of this report has been reprinted and made available to the Conference by M. K. E. Ford of the Georgia Experiment Station. In the introduction to the report the Committee says, "Basically, the problem confronting Southern agriculture is to improve the inherent quality of the products leaving the farm and to reduce costs--the cost of marketing as well as as the cost of production." Additional points which I think have a bearing on our topic were:

1. "Marketing research must be directed toward the development of better information for decision-making on the farm and throughout the marketing system."

2. "A marketing research program must be developed and carried out within an economic framework, but it must also include the technological aspects of marketing. Some methods of performing an operation may affect quality and, consequently, the selling price of the product. Undoubtedly, the most useful decision-making information must be developed through joint efforts of economists and technologists."

3. "The function of marketing research is not to establish the objectives nor to decide on the particular methods to be employed, but rather to recognize the objectives of people engaged in marketing, to identify the alternative methods of accomplishing the objectives, and to develop the information and procedures needed for a complete evaluation of alternative methods."

Let me repeat these functions of marketing research:

-- To recognize the marketing objectives,
-- To identify alternative methods, and
-- To develop information and procedures needed for a complete evaluation of alternative methods.

The Committee also identified five levels of decision-making toward which marketing research should be directed. These levels are: the stage, the plant, the firm, the industry, and the public.

This report by the Southern Marketing Research Committee, in my opinion, adequately described some of the needs for marketing research in the South. The Committee, in order to more clearly convey

their ideas, also developed a draft of a proposed regional project based on the Marketing Firm Adjustment Section of the research program which they proposed in A Framework for Marketing Research in the South.

This project is under way and is known as SM-30, entitled "Establishing Guides for Adjustments by Firms Marketing Fruits (Noncitrus) and Vegetables in the Southern Region." Dr. J. R. Beckenbach, Director of the Florida Agricultural Experiment Stations, is the Administrative Advisor, and Mr. K. E. Ford, Georgia Experiment Station, is the Chairman of the regional technical committee. Participating in SM-30 are the Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, and Puerto Rico Agricultural Experiment Stations and the Marketing Economics Division, Economic Research Service, USDA. The technical committee is composed of economists and horticulturalists working together "to develop the physical input-output data necessary for estimating costs of alternative methods of performing individual marketing operations by classes of fruits and vegetables.

SM-30 is developing this information for four areas. The technical committee has subcommittees for each of these areas. They are: assembly, transportation and distribution, processing, and storage, grading, and packing. The physical input-output data developed by the Committee is to be published in handbook form. SM-30 objectives are accomplished with the publication of the physical input-output information to which others might attach local factor prices in order to estimate costs of alternative methods for performing specific functions or operations.

Research in the processing area is under way at Alabama, Arkansas, South Carolina, Tennessee, and in the Marketing Economics Division of Economic Research Service. The processing subcommittee, with W. T. Manley of our Gainesville, Fla. office as chairman, has agreed upon the following classifications of data relating to processing:

1. Machinery and other equipment
2. Labor and management
3. Raw product
4. Buildings
5. Storage
6. Utilities (water, electricity, waste disposal, and fuel)

There is one project on peaches under SM-30. The South Carolina Station has a contributing project to SM-30 in which operations will be observed at peach canning plants of various sizes and capacities. The data will be obtained so that input-output coefficients can be computed for the various stages of canning peaches. In addition, flow charts will be developed so as to clearly identify the individual stages in canning peaches from the receipt of the peaches at the processing plant through to the storage of the canned peaches. From such data as these, estimates may be developed to show:

1. The physical requirements and costs of the various methods of performing the various jobs, stages, and functions involved in canning peaches.
2. The economics to scale (size) in canning peaches.

W. J. Lanham, Head of the Department of Agricultural Economics and Rural Sociology at Clemson University, is attending this Conference should you wish details on this project.

There are several research reports that illustrate the development and application of such input-output data and costs. One series of reports familiar to several of you are the publications under the general title, "Planning Data for the Sweet Potato Industry," by Richard A. King, Leigh H. Hammond, and Gene A. Mathia (1, 2, 3, 4, 5).

In conclusion, I should like to emphasize that the Southern Marketing Research Committee described the problem confronting Southern agriculture as one of improving the quality of the products leaving the farm and of reducing the costs of producing and marketing these products. The Committee emphasized that the economic framework for the marketing research must also include the technological aspects of marketing. I am glad that there is marketing research under way on the relative costs and efficiencies in processing peaches in the South.

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THIRD SESSION

CANNED PEACH PRODUCTS

Chairman, R. E. Brokaw, Georgia Canners Association, Griffin, Ga.

POSSIBILITY OF ESSENCE RECOVERY

by
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University of Georgia, Athens

Fully ripe peaches have a delightful fragrance. Processed peaches--though they are very pleasant--often lack some of the aroma fresh peaches have. Essence recovery is one possible way of producing peach products with maximum flavor.

Before beginning to discuss the advantages and problems involved in the preparation and uses of fruit essences, I'd like to anticipate the things I assume some of the following speakers are going to say. With reference to the storage of peaches and the processing of peach products, I'm quite sure the speakers to follow will point out the necessity for minimum heat treatment, enzyme inactivation, the use of ascorbic acid, and other processing steps which may need to be taken to retain natural flavor to the greatest degree possible. What I am to talk about is icing on the cake, and it perhaps should come after the cake is baked. Regardless of that, my talk is first among the processing talks. So I will discuss how to prepare the icing before the cake is even baked.

Approximately 25 years ago a companion USDA laboratory of the Southern Utilization Research and Development Division Laboratory, one of the sponsors of this Conference, developed a means of recovering the flavorful portion of apple syrup. My memory may be faulty in this respect, but the procedure really arose out of the shortage of sugar in World War II. The tobacco industry is a large user of sugar, alternate sources of syrup had to be found for the tobacco industry because refined sugars and the usual edible grades of syrup were needed more for food purposes than tobacco processing. In removing the apple flavor from apple cider so that a bland, flavorless syrup would result when the apple cider was concentrated, a second product was obtained, apple essence. This was a colorless liquid which contained a large part of the original apple flavor. Generally, all of the apple flavor would be contained in 10 percent or less of the original volume of apples. Bland syrups derived from flavorful fruits and fruit essences are still important today. Pear and pineapple canners, for example, make

concentrated syrups from juice which invariably seeps from the fruit as it is cut and use this syrup along with cane, beet, or corn sugar as sweetening agents. Fruit essences are prepared not only from apples but from other fruits such as grapes. The essence, added to apple or grape jelly after all heating is completed and just before the jelly is poured, contributes materially to a strong, natural, full apple or grape flavor. Peach essence might be used for the same purpose.

The methods of preparation of fruit essences vary. The most common way is to recover the first 5 to 10 percent of the volatile materials which come off the product as it is heated or subjected to a vacuum, as in vacuum cooking. The volatile material is captured by condensing it by cycling the vapors through a cooling unit such as a condenser. Since liquid nitrogen is readily available today, one can condense the most volatile of substances to give excellent efficiency in recovering all those flavor components wanted.

Now to be particular as to peaches:

1. Peach essence recovery itself would be unlikely to be a completely economical operation. Essence recovery needs to go along with some other industry such as dehydration because at best the flavor components constitute only a small part of the fruit (more about that later). Use needs to be made of the peach flesh or pulp to spread equipment and other costs over as many products as possible. There are some instances where sound fruit of good flavor might be suitable for essence recovery alone, but in general essence recovery needs to go along with the production of some other peach product. One thing any prospective processor needs to get out of his mind right away is that the fruit can be green, excessively bruised, or otherwise short of being fruit of eating grade. Sound, flavorful, fully ripe peaches will be needed to produce good peach essence. The peaches can be--probably they should be culls as to size or shape--but they must be sound, ripe fruit if a desirable peach flavor is to result.

2. Products for which peach essence would have particular value would be (1) jams and jellies (to restore to the jam flavors which boil off as a result of cooking), (2) fountain syrups or ice cream toppings, (3) ice cream itself, (4) fruit confections, (5) gelatin-based desserts, and (6) canned or frozen peach concentrates. Peach essence added to ice cream would be particularly desirable to fortify the flavor of peach slices or chopped fruit itself because at the low temperature of ice cream, flavors of exceptional strength are required to overcome decreased taste sensitivity caused by the low temperature. Peach essence might also have uses in certain pharmaceutical bases. Pharmaceutical bases often are made from fruit syrups, but a strong fruit flavor is needed to overcome the taste of the medicinal itself. In fact, this is probably why fruit syrups were used as pharmaceutical bases in the first place.

The suggestions for the use of peach essence above by no means exhaust possible uses. I am sure that each individual in this room could think up some additional products in which peach essence might serve to improve the product. With research, other uses could be found which are beyond our present knowledge or inventiveness today.

I would like to move now to another aspect of peach essence, namely, precautions which will need to be taken in preparing and storing it. I mentioned above that only a small portion of a fruit consists of the flavor components. You, naturally, are interested in peaches most of all. Under a research contract financed by the Southern Utilization Research and Development Division, USDA [1]/we have been investigating the identity of the flavor components of peaches. From 20 pounds of peaches we can concentrate nearly all the flavor components in less than 1 pound of extract. This is only a preliminary extraction, I might point out, but it is the type which would be suitable for peach essence. It is colorless and very strong in flavor. Added to water, in the ratio of 19:1 one comes back to approximately the intensity of fresh peaches. Actually, only a very small part of the 1 pound of extract is flavor. We have succeeded in concentrating the 1 pound of distillate further by pentane extraction, followed by evaporation of the pentane. We then get about 1/2 milliliter of an oily-like substance which is very powerful as a peach flavor. When we get to this point we have effected about a 445, 000 decrease in volume. You may be further interested in

1/ Contract No. 12–14–100–7729 (72).

the oily substance. It contains at least 35 compounds. If one figures back to the original peach, the concentrations of these compounds in the peach range from less than 1 part per million to 122 parts per million. In case you are not thoroughly familiar with the concept of parts per million, this means that if one were to extract 1 million pounds of peaches, one would get 1 pound of substance. You can see that it is possible to make essences which range in volume from about 5 percent of the original peach down to an exceedingly small volume which represents only one part in several thousand of the original peach. As the degree of concentration goes up, the strength likewise goes up.

The most concentrated essence is quite stable. At the 5-percent level, there is still a large amount of water in the essence. The essence needs to be stored in dark bottles or otherwise protected from light, because light causes some photochemical reactions which change the flavor balance of the essence. It should also be refrigerated to minimize chemical reactions and losses through volatilization. There will be some problems associated with the production, use, or marketing of peach essences, but they aren't insurmountable. On the contrary, the fact that the flavor substances are so powerful suggests they may be made to serve purposes for which peaches themselves are unsuitable. We notice, for example, that upon merely vacuumizing the peach preparation during the first stages of vacuum distillation to prepare peach essences the peach puree assumes somewhat of a cooked taste although no heat has yet been applied. We feel that some of the flavor changes we attribute to heat are in reality merely losses of volatile substances. By adding these substances back, processed products might be upgraded. In any event, commercial development of peach essences will be both a challenge and an opportunity.

EXPERIENCES IN CANNING PEACHES

by
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South Carolina Agricultural Experiment Station, Clemson

Anyone who has worked with peaches for any period of time will certainly have experiences, whether it be in canning, shipping, or some other phase of the peach industry. This queen of the fruits can be as lovely and vivacious, or as obstinate and temperamental as any prima donna who ever lived. My first recollections of peaches were the lovely canned fruits which my mother put up each year and which we ate during the cold winters of Oregon. We grew peaches on that farm but never made much money on them. When doing graduate work at Oregon State College, one of my tasks was to study the effect of different sugars on the canning of peaches. Since I came to Clemson in 1940, peaches have provided many interesting experiences.

There are three areas in the field of peach canning which I would like to discuss briefly. First is the raw product, second, problems associated with the actual canning of peaches, and third, some guesses on my part concerning developments which would be beneficial to the industry.

A canner must have a reliable source of raw material. This means a willingness on the part of both grower and processor to cooperate so that peaches can be delivered to a plant year after year, with both parties concerned having a reasonable chance to make a profit. Good grower-processor relations are essential for a healthy canning industry.

Consider the fruit itself, what do canners need in a freestone peach? Good size is important, because size affects labor cost, yield, and quality of the canned product. Later, I will show some slides on the effect of size on these factors; but, briefly if we consider 2-inch as compared to 2-1/2 inch peaches, we can see the tremendous effect that size has. The effect of size on peach canning is shown below:

		2 in. size	2-1/2 in. size	Present increase
Pitting rate--	bushels/hour	2.75	4.25	73
Hand packing into cans--	cases/hour	2.50	3.75	50
Yield--	cases per ton	34.50	42.50	23
Man-hours/100 cases--		152	80	90

On several occasions we have made studies on quality of freestone peaches canned at Clemson. For example, on orchard-run peaches we have been able to obtain only 42 percent choice grade (B) or better with Elbertas, 56 percent with Halehaven, and 62 percent with Triogem. The remainder were standard or substandard grade. A canner needs the very best possible grade he can get, if he plans to attempt to process for quality.

Freestone peaches for canning should pit easily. In the past, most of the peaches canned in the South were pitted by hand, and some tendency to cling could be tolerated. However, as mechanical pitters have developed, it has become clear that freestone peaches should be true to the name "free." It is now necessary to re-evaluate old and new varieties for their suitability for mechanical pitting. I should point out that the Altman pitter, manufactured only a short distance from here, has earned national acceptance in a few short years.

Varieties are not always easy to evaluate for freeness of the pit. As trees get older, the flesh tends to cling more, and sometimes it is necessary to secure 4 to 6 crops before making a final evaluation.

The mere mention of split or broken pits will make most canners shudder. For example, on an experiment on freezing approximately 1,000 bushels of peaches last summer, our labor costs doubled when we processed some beautiful Sunhigh high peaches--which ran 80 percent split pits.

Peaches for canning should ripen to a uniform yellow orange color. The Elberta peach is rather poor at ripening uniformly, and yet the Elberta has been and continues to be one of our best freestone canning peaches. There are several reasons for this, some of them being that they will consistently produce crops year after year. Elbertas generally go through a fairly heavy June drop with the result that the peaches tend to be larger. The Elberta is a relatively firm peach, it pits easily, and in general is fairly resistant to diseases on the tree and after the fruit has been harvested. There have been many new varieties introduced in the last few years. Some of these varieties give promise of being good canning varieties. Some of these are on display on the tables here in this meeting room. However, in spite of the fact that many of them look very good in our research canning tests, many frequently fail as a commercial canning peach because of the factors which we cannot completely evaluate. Some of the peaches that have looked good to us at times, but which have failed commercially, have been the Dixigem which has a tendency to cling, Golden Jubilee which pits quite easily but ripens unevenly and is too soft, and Keystone which has serious defects in the orchard. We have frequently picked varieties from young trees which we thought were good; but, as the tree got older, the fruit looked worse, and a tendency to cling became apparent.

Another factor that has caused considerable concern to the Southeastern peach canner has been the dark brownish discoloration which becomes apparent after canning. This brown color has been ascribed to the red color which is in the fresh peach. However, an examination of this problem shows that many highly colored early peaches such as Redhaven will show no brown discoloration after canning. This brown discoloration normally does not show up until that period of season about 1 week before Elbertas are harvested. In general, from that time on, the later the season, the more discoloration has been observed. Thus, peaches like Afterglow, will frequently, but not always, show severe brown discoloration. We have always said that the brown color was due to the red color originally in the peach, but we are now obtaining data which would indicate that it is not the red color but some other factor associated with the ripening peach.

When talking about peach canning in the Southeast, we usually assume they are freestone peaches. In recent years, the peach breeders have introduced several firm-fleshed Clingstone varieties suitable for growing in this region. They also make highly acceptable canned products. Several of these varieties are on display. There is a great potential for an increase in the canning of Clingstone peaches in the Southeast.

I have spent considerable time on attributes of the raw peach. The quality of the peach to be processed is extremely important to the canner. The following are some thoughts for future development. We need varieties in which all the peaches on the tree will ripen at one time. If breeders

cannot supply such varieties, then the application of growth regulators to a tree should be developed to bring all the fruit to maturity at the same time. This would simplify mechanical harvesting a great deal. Trained horticulturists could bring a crop to harvest periods at preset times, and then mechanical harvesters should be able to strip the trees.

It is also in the realm of possibility that growth regulators could delay the bloom period, past those late disastrous spring frosts. One can also visualize that control of the bloom period would also tend to have the fruit on a tree mature more uniformly. Given control of the time and uniformity of the maturing of peaches, and the control of postharvest decay, automation and mechanization of peach harvesting could be greatly increased.

In general, we need to improve the quality of our Southeastern canned peach. This is easier said than done, but a concerted effort of the canners of our region could put the Southeast in a position of leadership for canned peaches.

Some of the areas for improvement in the canning process are better pitters, improved peeling processes, segregation into more grades or products, and closer control over sterilization or cooking procedures.

DETINNING OF CANS USED FOR PEACHES

by
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American Can Co.
Tampa, Fla., and Maywood, Ill.

(Presented by D. J. O'Brien)

Gradual removal of the tin coating is a normal reaction inside a plain tinplate can packed with a moist food product. A controlled amount of detinning occurs as a by-product of the electrochemical protection which the tin provides for the base steel. Plain cans made of even the best steel will eventually detin completely and form hydrogen swells. 1/

Container recommendations by the can maker are designed to provide adequate corrosion shelf life for the product. When plain can parts are specified, enough tin is provided for protection during the time normally required for orderly distribution and consumption of the pack. With products where greater corrosion protection is needed, or where the dissolved tin might affect color and/or flavor of the product, the use of enamel-lined cans is usually recommended. 2/

It is possible for food products to contain substances which cause detinning to proceed more rapidly without involving normal electrochemical reaction. Instead the tin coating is subject to direct chemical attack. Copper and sulfur in most of its forms are two substances which accelerate detinning of plain parts of the can. For this reason, sulfur contamination through spray residues or other sources should be avoided, and copper-bearing equipment should not be used in the canning line.

Detinning of plain can parts tends to be more noticeable with electrolytic plate than with hot-dipped plate since the detinned areas are black instead of gray. The difference in color is traceable to a heavier alloy layer of different structure on the hot-dipped plate.

Test Packs of Peaches

With respect to detinning of cans for a moderately corrosive product such as peaches, there is one recurrent question: "What is the commercial significance of the problem?" The pros and cons of this question have been discussed many times. In final analysis the main consideration is

1/ "Internal Can Corrosion," R.B. Guyer. Technical Paper Presented at 59th Annual Convention, National Canners Association, Bal Harbour, Fla. (1966).

2/ "Container Coatings–Some Challenges and Changes," A.A. Kopetz and C.J. Poole. Technical Paper Presented at 59th Annual Convention, National Canners Association, Bal Harbour, Fla. (1966).

consumer opinion. Yet there is a lack of information on what the trade considers a satisfactory inside appearance on plain tinplate can parts. The tests described here were made to obtain some information on canner and consumer reaction to container detinning and discoloration, and particularly an insight into the type of inside can appearance considered objectionable. [3/]

Sample cans of various types were selected from packs of Clingstone peaches which had been stored for 31 months at room temperature (average 72° F.). All cans were 303 x 406 size and had plain #50 or #75 electrolytic tinplate bodies and enameled #25 electrolytic tinplate ends.

Emptied cans representing a broad range of plain body appearance from partial etching to 30 percent detinning were shown to a panel of 15 persons. The panel included 4 women consumers, 3 NCA representatives, 7 persons employed by peach canners, and a manager of quality control from a major supermarket chain. Each participant was given a complete set of empty cans and was told that the cans had been packed with peaches. It was explained that the purpose of the test was to gain some idea of what might be considered acceptable or objectionable from an appearance standpoint. Each panelist was asked to segregate the cans as he saw fit and comment on their appearance.

Acceptability Ratings on Detinned Cans

Table 1 shows service life data and panel acceptability ratings on the cans in this test. Although opinions varied, most panelists considered can appearances acceptable when 30 percent or less of the alloy layer was exposed (30 percent detinned). Surfaces with greater amounts of detinning were more likely to be questioned. Additional comments by the panel participants indicated that there is more objection to uneven patterns of corrosion on a can surface than to an overall pattern with approximately the same amount of detinning throughout.

Service life results on the cans in this test also were favorable. Performance of the cans during the 2-1/2-year storage period confirmed that plain bodied tinplate cans with the recommended #50 inside tin coating weight should provide ample protection for peaches during the time normally required for orderly distribution and consumption of the pack.

Table 1. --Results of test pack of Clingstone peaches stored 31 months at room temperature

Plate variables	Service life data: Average tin coating (including alloy layer) Before storage	Service life data: Average tin coating (including alloy layer) After storage	Service life data: Tin lost during storage	Body etching	Alloy layer exposed	Panel acceptability rating
	Llb/bbl.	Lb. /bbl.	Lb. /bbl.	Pct.	Pct.	
Control #75/25	0.71	0.60	0.11	90	0	15 OK
#50	.50	.36	.14	100	10	15 OK
#50	.52	.36	.16	100	10	15 OK
#50	.63	.49	.14	100	20	15 OK
#50	.50	.27	.23	100	30	11 OK (4 borderline)

3/ "Internal Container Appearance--"A Survey of Industry Opinion," S.J. Hotchner. Unpublished Laboratory Report, Technical Service Division, American Can Company, July 25, 1962.

INFLUENCE OF PRE-HARVEST AND POST-HARVEST FACTORS ON QUALITY OF PEACHES

by
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The material presented in this article pertains to results obtained at the Arkansas Agricultural Experiment Station and which appeared in a series of reports during a period from 1958 to 1962.

Pre-Harvest Factors

Irrigation, Pruning, and Thinning

The results reported in this section pertain to the influence of different levels of irrigation and different degrees of pruning and thinning on quality of Elberta peaches. The following experimental treatments were induced on a 12-year-old Elberta orchard during a 3-year period from 1958 to 1960.

Irrigation treatments. --(1) All-season orchard irrigation to supplement rainfall to 2 inches every 2 weeks beginning at pit hardening and continuing until harvest. (In 1960 this required a total of six irrigations.) (2) Irrigation to supplement rainfall to supply 2 inches of water every 2 weeks beginning at the start of final-swell. (In 1960 this required a total of two irrigations.) (3) Non-irrigated check plots.

Pruning treatments. --(1) Light pruning--removal of 10.9 pounds of wood per tree. (2) Heavy pruning--removal of 27.4 pounds of wood per tree (this simulated the pruning practice in the area).

Thinning treatments. --Immediately after the May drop, three fruit-thinning levels were accomplished leaving spacings between fruits of (1) 6 to 7 inches, (2) 4 to 5 inches, (3) 2 to 3 inches.

Fruits were harvested between the firm and firm-ripe stages of maturity. Fruit samples were collected for evaluating quality of raw and processed products. The samples were hydrocooled and brought to the Physiology and Processing Laboratory at Fayetteville, Ark. Duplicate samples were analyzed and processed upon arrival and also after storage at 70°F. for 2 days. The size of sample was 10 fruits for raw-product determinations and two 303 cans for processing. The constituents of quality measured were, for raw product: firmness, pH, soluble solids, titratable acidity, and flesh color; for processed product--taste and color. Firmness measurements were taken on 5 fruits from each treatment, using a Firmness Meter with a cylindrical chain and the non-linear attachment, with 1,000 g. test weight in the third position.[1/] Soluble solids, pH, and titratable acidity were determined from filtrate of a 1:2 blend (100 g. peach flesh to 200 ml. of distilled water). Flesh color measurements were made on five fruits using the Hunter Color and Color Difference Meter. Peaches were lye peeled and placed in 1 percent citric acid solution prior to determination of flesh color. The Color Difference Meter was standardized with a reference plate of values: L 52.0; a 3.3; b 30.9.

The data pertaining to quality of the raw product (table 1) include the main effects and the first-order interactions that were significant for any one determination. Reduction in firmness after 2 days of storage at 70° F. was enhanced under light pruning as indicated by pruning X days-of-storage interaction. This softening from light pruning was only obtained with final-swell irrigation as may be seen from the irrigation X pruning interaction. Percentage of soluble solids was decreased by irrigation which is in agreement with results obtained by Hendrickson and Veihmeyer in California, and by increasing the fruit load by lighter thinning, which is in accord with findings of many other workers.

Titratable acidity was increased by all-season irrigation, severe pruning, and heavy thinning. The pruning X thinning interaction also indicates that the increase in acidity by severe pruning was most evident with heavy thinning. Fruit pH was affected only by thinning, increasing as the fruit load increased; pH also increased during storage.

1/ ASCO Firmness Meter. Agricultural Specialty Co., Hyattsville, Md.

Table 1.--Effect of irrigation, pruning, and thinning levels on quality of raw and processed Elberta peaches, 1960

Treatment	Firm[1]	Percent Sol. Sol.	pH	Acid[2]	Flesh color[3]	Canned Taste	(Sensory)[4] Color
Irrigation:							
All season	6.36	12.70	3.55	3.61	0.234	3.0	2.3
Final-swell	6.64	12.83	3.53	3.24	0.256	3.8	2.3
None	6.46	13.75	3.57	3.16	0.223	2.4	1.8
L.S.D. 5 percent	N.S.	0.33	N.S.	0.32	N.S.	0.4	0.4
Pruning:							
Light	6.57	13.05	3.53	3.08	0.222	2.6	2.3
Severe	6.41	13.13	3.55	3.59	0.253	2.9	2.0
L.S.D. 5 percent	N.S.	N.S.	N.S.	0.22	0.025	0.3	N.S.
Thinning:							
6-7 inches	6.53	13.65	3.48	3.70	0.233	2.8	2.2
4-5 inches	6.45	13.08	3.55	3.28	0.251	2.8	2.3
2-3 inches	6.48	12.55	3.62	3.04	0.228	2.7	2.1
L.S.D. 5 percent	N.S.	0.33	0.05	0.32	N.S.	N.S.	N.S.
Days of storage:							
0 Day	5.38	13.30	3.53	3.43	0.212	2.0	1.9
2 Day	7.59	12.88	3.57	3.24	0.263	3.4	2.4
L.S.D. 5 percent	0.20	0.27	0.04	N.S.	0.025	0.3	0.3
Irrigation X Pruning:							
All season -							
Light	6.40	12.45	3.57	3.23	0.225	2.8	2.3
Severe	6.32	12.95	3.53	4.00	0.243	3.2	2.3
Final-swell -							
Light	6.90	13.15	3.52	2.95	0.220	2.8	2.7
Severe	6.38	12.50	3.55	3.53	0.292	2.7	2.0
None -							
Light	6.40	13.55	3.57	3.08	0.222	2.0	2.0
Severe	6.52	13.95	3.57	3.25	0.225	2.8	1.7
L.S.D. 5 percent	0.35	0.47	N.S.	N.S.	N.S.	0.5	N.S.
Pruning X Thinning:							
Light							
6-7 inches	6.70	13.70	3.48	3.20	0.219	2.5	2.3
4-5 inches	6.45	12.95	3.57	3.13	0.234	2.7	2.5
2-3 inches	6.55	12.50	3.60	2.93	0.215	2.5	2.2
Severe							
6-7 inches	6.37	13.60	3.48	4.20	0.248	3.0	2.0
4-5 inches	6.45	13.20	3.53	3.43	0.269	2.8	2.0
2-3 inches	6.40	12.60	3.63	3.15	0.242	2.8	2.0
L.S.D. 5 percent	N.S.	N.S.	N.S.	0.45	N.S.	N.S.	N.S.
Pruning X days of Storage:							
Light							
0 Day	5.34	13.33	3.53	3.20	0.190	1.9	2.2
2 Day	7.79	12.77	3.58	2.97	0.255	3.2	2.4
Severe							
0 Day	5.42	13.27	3.52	3.67	0.234	2.1	1.6
2 Day	7.39	13.00	3.58	3.52	0.272	3.7	2.4
L.S.D. 5 percent	0.29	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

1/ As measured by ASCO Firmness Meter. 1000 gms.–30 seconds-nonlinear X 3.
2/ Milliliters of 1/10 N NaOH to neutralize 5 g. of peach pulp.
3/ Hunter Color Difference Meter a:b ratio.
4/ Rating of 1 to 4 for taste and 1 to 3 for color, with the higher figures indicating more desirable ratings.

(Data from Norris and Kattan. 1962. A.S.H.S. 80:177-189.)

Storage was the strongest factor affecting color, and flesh color of all samples improved upon storage as shown by the Hunter C. D. M. a/b ratio for flesh color (table 1). Severe pruning was the only pre-harvest factor that increased flesh color. Sensory evaluation of the canned samples indicated that both all-season and final-swell irrigation produced a more acceptable canned product, especially in terms of taste and color. Severe pruning also was associated with improved taste. Overall quality of the canned product was impaired when a heavy fruit load was allowed without irrigation. This was particularly evident in terms of taste. This effect of irrigation and pruning on taste may have been a result of the higher acid content of the raw product. Taste and color of all samples improved upon storage of the raw product for 2 days at 70° F. prior to processing. It was of interest to note that in this study the cultural factors which yielded the highest percentage of large fruit, also produced the best canning quality.

Varieties

In this study 26 fresh-market varieties were evaluated for their adaptability to canning and/or freezing.

Fruit samples were obtained from the variety orchard at the Main Station at Fayetteville. These were harvested within the firm-ripe stage and processed at the Physiology and Processing Laboratory. All samples were peeled in 3-percent lye solution and packed in 40° Brix syrup. A commercial citric-ascorbic antioxidant was added to the syrup of the frozen samples.

These samples were evaluated for wholeness, color, discoloration, and flavor, along with several commercial packs of peaches. Details of quality aspects of these varieties are presented in tables 2 and 3. However, overall acceptance of these varieties may be summarized as follows:

For Canning

Excellent: Keystone, Sunhigh, Vedette
Good: Dixigem, Southland, Elberta
Acceptable: Sungold, Primrose, Ranger, Triogem, Redhaven

For Freezing

Excellent: Ranger, Blake
Good: Elberta, Redhaven, Keystone, Sunhigh
Acceptable: Dixigem, Southland, Richhaven, Vedette, Sungold, Triogem

In another variety evaluation, cling peach varieties that were developed for baby food processing were evaluated in an attempt to provide objective translations of the conventional sensory ratings into objective values. This study was not designed to evaluate these varieties for their adaptability for baby food, because initial fruit maturity of all varieties was not standardized.

Samples for these evaluations were prepared by the Gerber Products Company and sent to the Physiology and Processing Laboratory at Fayetteville where the samples were analyzed for objective values, and sensory ratings were made.

Tables 4 and 5 indicate that objective values would be more reliable and would allow comparisons of processed samples regardless of their origin. As can be seen in table 5, the use of the Color Difference Meter is an excellent objective method for determining the color of baby food puree.

Post-harvest Factors

Changes in Raw Product

To help design a schedule for handling peaches, a study was made of changes in quality of Elberta peaches ripened at 70° F. Three different stages of maturity were used--hard, firm, and firm-ripe. The ripening treatments were conducted either before or after cold storage at 32° F. for 7 or 14 days.

The data in table 6 show the changes in quality of fruits exposed to 70° F. for different periods. Surface color is reported in terms of redness (Hunter a) and firmness as ASCO Firmness Meter values. Subjective ratings of 1 (inedible) to 5 (excellent) were used for taste and texture.

A well designed and controlled ripening schedule may improve considerably the raw product quality of peaches, and especially that of less mature fruits. Ripening was enhanced when preceded by cold storage. This was most evident in the reduction of fruit firmness and acid content, and yet the incidence of storage rots was lower than when fruits were held in cold storage after ripening at 70° F.

Table 2. --Quality evaluation of peach varieties for canning adaptability, 1960

Variety	No.	Whole[1]	Color[1]	General appear.[1]	Flavor[1]	Remarks	Adaptability
Cardinal	1	*	-	-	*		
Dixired	2	-	-	-	-		
Redcap	3	-	-	-	-		
Early-Red-Fre	4	-	-	-	-	White flesh	
Early Fair	5	-	-	-	*		
Sunhaven	6	-	*	-	*		
Cornet	7	-	*	-	*		
Dixigem	8	*	**	**	*		Good
Redhaven	9	-	*	-	**		Acceptable
Keystone	10	*	*	**	**		Excellent
Triogem	11	-	*	*	*		Acceptable
Newday	12	-	-	-	-		
Ranger	13	*	*	*	*		Acceptable
Richhaven	14	**	-	-	*	Red pigment discolored	
Sunhigh	15	**	**	**	*		Excellent
Southland	16	*	**	**	*		Good
Lola Queen	17	-	-	-	-	White flesh	
Vedette	18	*	**	*	**		Excellent
Polly	19	-	-	-	-	White flesh	
Redelberta	20	-	-	-	*		
Fairhaven	21	*	-	-	*	Red pigment discolored	
Redcrest	22	*	-	-	*		
Blake	23	*	-	-	-	Red pigment discolored	
Elberta	24	*	**	*	*		Good
Primrose	25	*	*	*	*		Acceptable
Sungold	26	*	*	*	*	Red pigment discolored	Acceptable
Comm. cling	A	**	*	**	-		
Comm. cling	B	**	**	**	*		
Comm. cling	C	**	**	**	*		
Comm. free	D	-	-	-	-		
Comm. free	E	*	*	*	*		
Comm. free	F	*	*	*	**		

[1] **= outstanding, *= acceptable, - = poor.

(Data collected by Kattan, Morris and Rom.)

Table 3. --Quality evaluation of peach varieties for freezing adaptability. 1960

Variety	No.	Whole[1]	Color[1]	Discolor[1]	General appear.[1]	Flavor[1]	Remarks	Adaptability
Cardinal	1	-	-	*	-	-		
Dixired	2	-	-	*	-	-		
Redcap	3	-	-	*	-	-		
Early-Red-Fre	4	-	-	*	-	-	White flesh	
Early Fair	5	-	-	-	-	-		
Sunhaven	6	-	*	*	*	-		
Cornet	7	-	-	*	-	*		
Dixigem	8	*	*	**	*	*		Acceptable
Redhaven	9	*	*	**	*	**		Good
Keystone	10	*	**	**	**	*		Good

Table 3. --Quality evaluation of peach varieties for freezing adaptability. 1960 (Continued)

Variety	No.	Whole[1/]	Color[1/]	Discolor[1/]	General appear.[1/]	Flavor[1/]	Remarks	Adaptability
Triogem	11	*	-	*	*	**		Acceptable
Newday	12	-	-	-	-	**		
Ranger	13	**	**	**	**	**		Excellent
Richhaven	14	*	*	**	*	*	Red pigment accept.	Acceptable
Sunhigh	15	*	**	*	*	**		Good
Southland	16	*	**	*	*	*		Acceptable
Lola Queen	17	*	-	*	-	-	White flesh	
Vedette	18	*	*	*	*	**		Acceptable
Polly	19	*	-	*	-	-	White flesh	
Redelberta	20	-	-	*	-	*		
Fairhaven	21	*	-	-	-	**	Red pigment discolored	
Redcrest	22	*	-	*	*	-		
Blake	23	**	**	**	**	**	Red pigment attractive	Excellent
Elberta	24	**	*	*	*	**		Good
Primrose	25	*	*	*	*	-	Red pigment accept.	
Sungold	26	*	*	*	*	*	Red pigment accept.	Acceptable
Commercial	A	*	-	-	-	-		
Commercial	B	*	-	-	-	-		
Commercial	C	*	*	*	*	**		

1/ **= outstanding, *= acceptable, – = poor.

(Data collected by Kattan, Morris, and Rom.)

Table 4. --Quality of cling peach varieties, 1962

VARIETY	OBJECTIVE				SENSORY
	Consist. Bostwick	Sol. Sols. percent	pH	Acid[1/]	Taste
Ambergem	8.0	23.8	3.9	5.45	Sl. acid
Baby Gold 5	7.0	20.9	4.1	5.70	Good
Baby Gold 7	9.0	19.5	4.1	4.95	Bland
Baby Gold 8	8.0	21.1	4.0	7.75	Very acid
Baby Gold 9	8.5	21.4	4.0	6.70	Acid

1/Acid: ml. of N/10 NaOH to neutralize 10-g. sample.

(Data collected by Physiology and Processing Laboratory, Fayetteville, Ark.)

Table 5. --Color of cling peach varieties, 1962

VARIETY	OBJECTIVE			SENSORY
	Color: Hunter Values			Color
	L	a	b	
Ambergem	37.7	9.1	22.7	Good
Baby Gold 5	38.6	10.7	23.9	Best
Baby Gold 7	38.3	8.4	23.0	Average
Baby Gold 8	39.1	8.6	22.8	Discolored
Baby Gold 9	38.2	7.6	23.0	Poor

Table 6. --Post-harvest changes in quality of Elberta peaches, during ripening at 70°F. [1/]

Days at 70°F.	Color (aL)	Firm-ness	Acid me/100 mg.	Percent sol. solids	Taste	Texture	Rot
Maturity--hard:							
0	-2.5	2.0	10.3	13.5	2.3	2.0	-
1	1.5	2.2	9.8	13.2	2.8	2.5	-
2	4.7	3.4	9.5	13.7	3.0	3.3	-
3	6.1	4.7	9.7	13.5	3.7	3.7	-
4	8.2	6.3	10.3	13.8	3.3	4.2	-
Maturity--firm:							
0	7.9	2.4	8.8	13.0	4.0	3.3	-
1	11.4	3.2	8.9	12.3	4.2	4.2	-
2	12.3	4.3	8.6	12.9	4.0	4.7	+
3	12.3	5.5	8.7	12.6	4.2	4.3	-
4	16.1	7.3	9.0	13.0	4.3	5.0	++
Maturity--firm ripe:							
0	14.5	3.4	7.9	13.1	5.0	4.3	-
1	15.8	4.6	7.9	14.0	5.0	5.0	-
2	18.2	5.3	7.8	13.6	5.0	5.0	+
3	20.2	6.8	8.0	14.0	5.0	5.0	++
4	20.8	8.9	7.8	14.1	4.7	5.0	++

1/ Averages of all cold storage schedules.

(Data from Kattan and Morris. 1958. Ark. Farm Res. Vol. 7 (2): 3.)

Quality of Processed Product

There has been a trend to harvest at less mature stages and allow the fruit to ripen before processing. This practice minimizes bruising during harvest and shipping. A study was conducted to determine the effect of this practice on quality of the processed product. It included two varieties--Redhaven and Elberta--and three maturity stages--hard, firm, and firm-ripe. Samples were processed after 0, 2, 4, or 6 days of ripening at 70°F.

The advantage of a ripening program is primarily for improvement of flavor and color. As may be seen in table 7, the flavor of peaches

Table 7. --Effects of maturity and length of ripening on quality of canned and frozen peaches, 1960 (Average results for Redhaven and Elberta)

Maturity and days held at 70°F.	Flavor 1/		Color 1/		Color 1/
	Canned	Frozen	Canned	Frozen	(a)L
Harvested "Hard"					
0	-	-	-	-	-0.2
2	*	-	-	-	1.9
4	*	*	*	*	2.7
6	*	*	**	*	4.3
Harvested "Firm"					
0	-	-	-	-	1.3
2	*	*	-	*	2.0
4	**	**	*	*	3.0
6	**	*	**	**	4.2
Harvested "Firm-ripe"					
0	*	*	*	*	2.1
2	**	*	*	*	2.4
4	**	*	**	**	4.2
6	*	-	**	**	4.6

1/ Sensory rating: –, poor; *, acceptable; **, outstanding.
2/ Hunter (a)L values of color of canned product.

(Data from Kattan, Morris, and Rom. 1960. Ark. Farm Research, Vol. 9 (6):4.)

harvested at the "hard" and "firm" stages was poor when the fruit was processed immediately after harvest. Flavor of these grades, however, improved with ripening at 70° F. to equal that of the "firm-ripe" stage. This was quite evident in the "firm" grade which, after 4 to 6 days of ripening, was superior in quality to the "firm-ripe" peaches processed at harvest. Color likewise improved during ripening. Its sensory evaluation was verified by the Hunter (a)L values presented in table 7.

PEACH FLAVOR AS RELATED TO PROCESSING

by
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Flavor, as in other food items, is an important quality in fresh and processed peaches. The popular concept of flavor is synonomous with taste. However, flavor is more as an elusive and complex blend of sensations, including the two major components of aroma and taste, and to some extent, also other sensory responses such as touch and vision. Taste itself comprises the four main components, salty, bitter, sweet, and sour. Aroma or odor, on the other hand, is generally dependent on volatile components or volatile carriers.

The characteristic flavor of the peach is understandably dependent to a larger extent, on the volatile aroma components--since other taste-flavor components such as sugars, acids, and tannins are common in all palatable fruits.

In the development of peach products, we were striving to preserve as much as possible the characteristic flavor of peaches. Consequently, it was desirable that a method be developed for determining changes in peach aroma due to different processing conditions as an objective measurement complementary to sensory evaluations. It was essential that the method be requiring only a small sample, that mild conditions be used to minimize changes in obtaining the aroma, and that the isolated aroma be amenable to analysis in a very short time. This paper reports the volatile flavor of peaches related to processing under the above-stated objectives.

Review of Literature

The work on characterizing the volatile components of peach is rather meager. Power and Chesnut (10) using atmospheric steam distillation of 100 to 150 kg. of Georgia Belle peach pulp, obtained 7 to 8 p. p. m. of an aroma oil, extracted by ether from the ice-cooled distillates. Through hydrolysis, this aroma oil was shown to consist chiefly of linalyl esters of formic, acetic, valeric, and caprylic acids, although the individual linalyl esters had not been actually isolated. Acetaldehyde was estimated to constitute about 25 percent of the aroma oil, and accounted for almost all of the aldehydic constituents. There were indications of small amounts of methyl alcohol, some free volatile acids, and a paraffin hydrocarbon, possibly cadinene.

For the estimation of the total volatiles in fruits, most workers employed the method of Friedman and Klaas (2), essentially for the oxidation of alcohol by alkaline permanganate. This method was used by Leonard and others (6) for determining the total volatiles in canned peaches, and by Guadagni and Dimick (3) in peach puree and frozen peaches.

Lim and Romani (8), using gas chromatography for the analysis of volatiles of peaches, have reported four components from Elberta variety and nine fractions from Redglobe variety. Only one volatile component, ethylene, was identified.

Jennings and Sevenants (5) starting with six tons of Redglobe peaches, have identified benzaldehyde, benzyl alcohol, gamma-caprolactone, r-octalactone, r-decalactone, and delta-decalactone as volatile components of the peach essence. They stated that none of these compounds duplicated the peach aroma.

No information has been found in the literature relating to the changes of individual volatile components in processed peaches.

Methods

In preliminary experiments the conventional permanganate oxidation method was

used to estimate total volatiles from peaches. This method was found to be inadequate as a dominant proportion of alcohol was present in the aroma constituents of peaches, and interference due to sulfur dioxide was also encountered in sulfite-treated peach products.

The development of gas chromatography appeared to provide a practical means of measuring the peach aroma qualitatively and quantitatively. The use of headspace vapors over fruits and vegetables for aroma analysis by gas chromatography has been suggested (1, 9). Our attempts had shown that the concentrations of the aroma in the headspace vapors of peaches and peach products were too low for analysis by gas chromatography.

The final procedure developed for the analysis of peaches aroma consisted of concentration of aroma by low temperature vacuum distillation and analysis of the aroma aqueous concentrate by gas chromatography utilizing a flame-ionization detector.

Concentration of aroma. All-glass laboratory apparatus was routinely used for concentration of peach aroma. The vacuum-distillation unit consisted of a Nester-Faust rotary evaporator (2-liter capacity), connected to a water condenser, followed by a flask for collecting the distillate, and a vapor trap cooled by salt-ice mixtures. Vacuum was provided by a mechanical pump.

A sample of 100 to 200 g. fresh or processed peaches was comminuted with equal weight of distilled water in a Waring Blendor, and the mixture transferred to the evaporator, heated by a water bath of 50°C. The condenser and flask were cooled with ice water at 8°C., and the vapor trap maintained at -15°C. A vacuum of 29 in. Hg was applied. As soon as the desirable vacuum was reached, the system was closed to prevent aroma loss through the pump. Under these conditions, distillation was stopped when about 120 to 240 ml. of distillate were collected in the flask and about 5 to 10 ml. liquid were obtained in the trap. Practically all the aroma was concentrated in the salt-ice trap. As analyzed by gas chromatography, therefore, only the aqueous solution containing the peach aroma in the trap cooled by salt-ice was considered. Reproducibility of the total procedure was satisfactory, and recovery of added benzaldehyde was in the range of 70 to 80 percent.

Analysis by gas chromatography. An F&M Scientific Model 702 dual-column linear temperature-programmed gas chromatograph with a flame ionization attachment No. 1609 was used. Columns were of stainless steel, 1/4 in. X 6 ft. packed for routine analysis with 20 percent (w/w) Carbowax 20M on Diatoport S (60-80 mesh).

Analysis of the aroma in aqueous solution was carried out with 10 to 20 microliter samples. Operation conditions were: Helium as carrier gas, flow rate, 90 ml./min.; air, 380 ml./min.; hydrogen, 50 ml./min.; injection port temperature, 200°C.; block temperature, 220°C.; column temperature, 140°C. for 2 min.; then programmed 7.5°C./min. to 185° or 225°C. The chart speed was 30 in. per hr. on a 1-mv recorder.

Identifying volatiles. Identification of some of the volatile components of peaches was primarily by retention-time studies with authentic compounds on Carbowax and diethylene glycol succinate columns, and by cochromatography.

Sensory evaluation. A trained taste panel was utilized for the sensory evaluation of fresh and processed peaches as well as the isolated fractions of aroma from them for gas chromatographic analyses.

Materials

Over 30 varieties of Georgia peaches were used for aroma studies. These included the Cardinal, Coronet, Dixigem, Dixiland, Dixired, Elberta, Early-Red-Fre, Halehaven, Hiland, Jefferson, Keystone, Loring, Melogold, Moore's Early Red, Nectar, Ranger, Redcap, Redglobe, Redhaven, Redskin, Southland, Sullivan Elberta, Sunburst, and a number of unnamed peach seedlings grown by V. E. Prince of the Breeding Program, USDA Field Station at Fort Valley, Ga.

Hundreds of samples of peach products over the 3 year period (1963-1965) were examined to follow the changes in the volatile aroma as brought about by various processing treatments. However, the application of the rapid scanning procedure to the studies of volatile aroma is illustrated only in this report in a few representative samples of fresh and processed peaches as follows.

Peach puree base for drinks and ice cream. Peach puree base in this example was prepared from Coronet peaches. Detailed procedure for preparation was described by Woodroof and coworkers (11). Essentially, the puree base for drinks had been pasteurized at 190-200° F., and that for ice cream had only been heated mildly at 145° F. to inactivate the enzymes.

Refrigerated fresh sliced peaches. The preparation was from Coronet variety. Detailed procedure for preparation was described by Heaton (this conference) and by Woodroof and others (11). The changes of volatiles were compared after refrigeration for 1, 28, and 63 days.

Clear peach juice concentrate. The juice was made from fresh, peeled and pitted Elberta peaches, depectinized, and concentrated from 10 to 32 percent soluble solids under a vacuum of 29 in. Hg at 140° F.

Canned peaches. Elberta peaches were canned in the usual manner in 35 percent syrup, and pasteurized 25 min. at 212° F.

Partially dehydrated pasteurized peaches. This sample was prepared from Halehaven peaches by an improved method involving vacuum impregnation of the peaches with syrup and other ingredients, and dehydrated to about 50 percent moisture. Detailed procedure for preparation was described by Woodroof and Li (this conference) and by Woodroof and coworkers (11).

Frozen peaches. A comparison was made between peeled, pitted Sullivan Elberta peach halves, with and without addition of 17 percent sugar, after 1-year storage at 0° F.

Irradiated peaches. Southland peaches were irradiated with 160,000 and 300,000 rad from a cobalt-60 source at the University of Florida.

Results and Discussion

The results of analyses of the volatiles in processed peach products by gas chromatography were summarized in table 1, with some of the volatile components tentatively identified. All the concentrations of the same volatile component listed in this table were calculated on the same basis and are comparable. Since the concentration of a definite compound is proportional to the height of the peak under same operational conditions, this height, corrected, was used to represent the concentration of the same component. In cases where very low level concentrations must be determined, the sensitivity of the detector was greatly increased so as to obtain a distinct peak, which, however, when corrected to the common reference, only measured in fractions of a millimeter. Retention time of a component on gas chromatograms may differ on occasions. However, by mixing the solutions, or cochromatography with a standard, definite assignment of a peak number is possible.

In all fresh peaches the concentrated aqueous aroma used for gas chromatography was assessed by taste panel to have strong peach aroma, and such distilled aroma obtained from processed peaches correlated to a certain degree with the aroma of the products evaluated organoleptically.

From table 1, it can be seen that mildly heated puree and heated puree contained the same number of volatile components, but that the concentrations of these components were greater in the mildly heated puree than in the heated puree. However, by comparison with the fresh peaches from which these purees were made, some volatile components were lost or undetectable in these purees, and the concentrations of the remaining volatile components were greatly reduced. Taste panel preferred the mildly heated puree as it had more aroma.

In the refrigerated fresh sliced peaches, the process reduced the number of volatile components as well as the concentration of the remaining components. On storage at 32° F., there were further decrease in number and concentration of the volatile components. However, after an extended period of storage, for example 63 days in present case, concentrations of some of the components were increased, especially component No. 11, which had raised after a decline to about 2-1/2 times its concentration in the unprocessed peach. Peak No. 11 was shown to be benzaldehyde. This observation correlated well with sensory evaluation in that an increase of almond-like flavor was noticed in these products upon storage. The increase in concentration of the benzaldehyde component and other components on storage indicated

some slow but active enzymatic reactions during storage of the products at the refrigerated temperature of 32°F., since the products had not been pasteurized to inactivate the enzymes. The increase in benzaldehyde was probably due to the hydrolysis of amygdalin by emulsin in the peach.

The concentration of Elberta juice, as shown in table 1, drastically reduced the number and concentration of volatile components. In fact, the aqueous aroma only contained the more volatile components with retention time less than 2 minutes, while all the other volatile components Nos. 6 to 11 had been lost or undetectable. Sensory evaluations showed that the aqueous aroma did not resemble peach aroma, and that peach aroma was lacking in the juice concentrate. This severe loss of aroma was expected, as it also happened to many other fruit concentrates.

The effect of canning was accompanied by decrease in the number and concentration of the volatile components. However, in contrast to concentrated peach juices, the higher boiling components No. 10 to 11 were retained to a certain degree in addition to those five components of higher volatilities, although components Nos. 6 to 9 were lost. Sensory evaluation of the aqueous aroma showed that such aroma was no longer of fresh peach, but of a cooked peach aroma, which is also the familiar aroma of canned peaches. The above findings indicated that components Nos. 1 to 5 did not by themselves represent the peach aroma, and that the addition of components Nos. 10 to 11 to this group only brought about some cooked peach aroma, and that it would require all the volatile components Nos. 1 to 11 to give a fresh peach aroma.

The effect of dehydration of peaches on the decrease in number and concentration of the volatiles followed similar pattern of canned peaches, as shown in table 1.

In comparison of the effect of added sugar on the volatiles of frozen peaches, it is seen from table 1 that fruits preserved with added sugar contained more components than those without added sugar. The taste panel preferred to the former because some fresh peach aroma was retained. The high concentration of component No. 11 in the case of the frozen peaches with added sugar was probably due to the effect of sugar in preserving the generated benzaldehyde on storage--similar to that of refrigerated fresh sliced peaches.

Irradiation of peaches, primarily as a means of pasteurization to extend the shelf life of fresh fruit, adversely affected the aroma and flavor, as noted by sensory evaluation, in proportion to the intensity of irradiation dosage applied. This was supported by the findings as presented in table 1, in that the concentrations of the volatile components in the irradiated peaches were decreased in comparison with those of the nonirradiated peaches. However, the decreases were much more severe with the higher dosage of 300,000 rad than with 160,000 rad. It has been shown that in tissues containing large amounts of water, highly reactive hydroxyl-free radicals were generated by irradiation. These free radicals would, in turn, oxidize, hydrate, or alter the volatile components.

By the use of a gas chromatograph equipped with a highly sensitive flame-ionization detector, it was found possible to analyze the peach-volatile aroma by direct injection of the concentrated aqueous aroma solutions. Unlike the thermal conductivity detector, the sensitivity of a flame-ionization detector is not dampened by water. This choice also circumvented the necessity of further concentration of the aroma, which would require considerable additional time, or handle the problem of a large volume of organic solvent in extracting the aroma from the aqueous solution, and concentrating the impurities from the solvent in recovery of the aroma by evaporating the solvent. In the present procedure, injection of samples at 140°C. was necessary, as the samples contain predominantly water. At a lower injection temperature, some water was apparently absorbed by the column, and was later released to give many extraneous peaks when the column temperature was increased. The whole procedure of analysis of volatiles by gas chromatography could be completed within 1 hour.

In using the present procedure, no claim is made to isolate and identify all volatile aroma in peaches. In fact, it is probably that some peaks contain more than just a single compound. Further progress in the studies of flavor of peaches would be possible

Table 1. --Gas chromatography of the volatile components of fresh and processed peaches

Variety	Treatment	Peak No.[1/] 1	2	3	4	5	6	7	8	9	10	11
		0.2	0.7	0.9	1.3	1.8	4.3	5.4	7.2	8.5	11.2	12.0
		Concentration of components as peak height in mm.										
Coronet	Fresh	-	178	230	220	360	0	100	5	3	8	17
Coronet	Pureed, mild heat	-	23	20	37	21	0	0	0	0.6	1	1
Coronet	Pureed, heated	-	20	27	35	18	0	0	0	0.2	0.2	0.2
Coronet	Refr. sliced, 1 day	-	62	114	120	128	0	5	1	0	2	4
Coronet	Refr. sliced, 28 days	-	20	110	100	108	0	0	0	0	0	2
Coronet	Refr. sliced, 63 days	-	39	35	111	120	0	0	0	0	0	41
Elberta	Fresh juice	10	9	240	285	160	18	49	7	4	22	3
Elberta	Conc'd juice	8	6	21	158	33	0	0	0	0	0	0
Elberta	Canned	2	2	205	198	188	0	0	0	0	2	1
Halehaven	Fresh	20	235	149	271	143	0	176	55	66	6	3
Halehaven	Dehydrated	3	27	27	260	61	0	0	0	0	2	1
Sullivan Elberta	Frozen + sugar	3	1	79	52	298	5	1	5	2	3	145
Sullivan Elberta	Frozen, no sugar	1	27	93	44	350	0	0	0	0	4	4
Southland	Nonirrad.	4	103	68	150	0	17	43	15	32	0	3
Southland	Irrad. 160 Krad	3	81	47	160	0	7	12	18	19	0	2
Southland	Irrad. 300 Krad	3	43	46	142	0	3	6	1	10	0	1

1/ Tentative peak identity: (2) Acetaldehyde, (4) methanol, (5) ethyl hexanoate, (7) methyloctanoate, (10) linalool, linalyl formate, (11) linalyl acetate, benzaldehyde.

only by an extensive investigation using larger quantities of raw materials for quantitative analysis, more elaborate means of recovery and concentration, and the employment of more refined instrumental identifications such as infrared spectroscopy, nuclear magnetic resonance, and mass spectroscopy. A correlation between the isolated chemical entities contributing to aroma and the sensory evaluation is also essential. This phase of study is currently carrying on since 1964.

The gas chromatograms of the processed peaches seemed to have served the purpose of rapid objective evaluation of aroma changes rather well, in spite of the lack of positive identification of many of the aroma components. Holley and coworkers (4) suggested that a quantitative analysis of the total ester volatiles and an estimation of a single volatile component-methyl anthranilate in grapes to be a good method for quality-control purposes. Buttery and Teranishi (1) were of the opinion that identification of aroma peaks on gas chromatograms from vegetables and fruits was not necessary in order to study the changes in aroma quality. Based on the results obtained in present study, the rapid scanning method as described should be helpful in establishing optimum procedures in developing high-quality fruit products by screening raw materials with better initial aroma, while other desirable qualities being equal, and by noting higher aroma retention in the finished products. In products in which it is not possible to retain the desirable volatile aroma components, such as in concentrates and dehydrated products, a process to capture the volatile aroma and to return the same to the finished products would be desirable.

Although designed primarily for rapid scanning of the volatiles of fresh and processed peaches, this method was also successful in obtaining distinct gas chromatograms of two varieties of apples, Red Delicious (19 peaks) and McIntosh (19 peaks), that showed some striking differences both in quality and quantity (7). This technique should be generally applicable to other fruits and their products.

Summary

Volatile aroma components in fresh and processed peaches were concentrated by vacuum distillation. The aqueous aroma concentrate was used directly for aroma analysis by gas chromatography on Carbowax

20M columns, utilizing a flame-ionization detector. Gas chromatograms of processed peach products, such as purees, refrigerated fresh slices, clear juice concentrates, canned peaches, dehydrated peaches, frozen peaches, and irradiated peaches, showed more or less severe decrease in number and concentration of the volatile components as compared to those of fresh raw materials. This relatively simple, rapid, and semi-quantitative procedure which requires only 1 to 200 g. of sample, could be a useful means of quality control in development of better products from other fruits.

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DISCUSSION

Question: How did the doctor arrive at 17 percent sugar where you have more flavor?

Dr. Li: By adding the sucrose, 17 percent of the weight of peaches that could be frozen.

Question: Did you go through a series of tests at arriving at that 17 percent?

Dr. Li: No, it was just a comparison of frozen peaches without sugar and with 17 percent sugar.

Question: Donald O'Brien, what varieties of peaches were you using in those tests?

Mr. O'Brien: Clingstone back in California.

Question: Dr. Powers, I understood you to say that you made a 20-fold essence with heat?

Dr. Powers: No, no, vacuum distillation.

Question: You have no experience with it--say something like making a stripping and making a hundred-fold essence or going that high.

Dr. Powers: Well, I don't think you can get a hundred fold.

Question: I don't think we could go that high on the peach essence.

FOURTH SESSION

CANNED PEACH PRODUCTS (continued)

Chairman, C. R. O'Kelly, Cooperative Extension Service,
University of Georgia, Athens

PROCESSING PEACH PICKLES

by
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Hunt-Wesson Foods, Fullerton, Calif.

Peach pickles are those peaches that are packed whole with the addition of spices and vinegar to the packing medium, which is usually extra heavy syrup. I will not attempt to distinguish between the terms "spiced peaches" and "sweet pickled peaches" as I think they mean essentially the same thing. I do not know of any major processor who packs a pickled (that is, vinegar added) unspiced peach; nor do I know of any processor who packs a spiced peach without the addition of vinegar. The pickled product packed under the Hunt label is a whole peach, whose pit has been loosened, but not removed. Spiced peaches may also be packed as halves. Spiced peaches may be packed in glass as well as in tin cans.

Pack Statistics

The annual pack of spiced peaches or pickled peaches is very small compared to the United States canned peach pack. Table 1 shows a comparison of canned peaches and canned spiced peaches for the period 1960-64. The figures are from National Canners Association's Division of Statistics. It can be seen that the total spiced peach pack is only about 1.3 percent the size of the U.S. canned peach pack. You will notice also over this 5-year period that there appears to be a rather general increase in the total canned peach pack; the short pack in 1965 does not represent a drop in consumption as much as it reflects lost production due to a severe outbreak of brown rot in California in August 1965. The pack of spiced peaches or pickled peaches does not show an upward trend. On the contrary, it might be inferred that there is a slight drop in consumption of canned spiced peaches, although it is not possible to say whether this is a temporary slippage or not. I think one of the reasons why canned spiced peaches have never enjoyed a higher volume is that they are thought of generally by the public as a specialty item, popular around the holidays. In my own company, Hunt-Wesson Foods, we have several canning lines for halves and slices in our four California canneries that pack cling peaches; by contract, we have only one 2-1/2 size line for spiced peaches at one cannery in Oakdale, Calif.

Table 1. --Comparison of production of canned peaches and canned spiced peaches

Year	Canned Peaches 1/ Thousands	Canned Spiced Peaches 1/ Thousands	Percent Spiced
1960	34,400	848	2.5
1961	34,950	648	1.9
1962	37,260	698	1.9
1963	36,670	465	1.3
1964	42,200	561	1.3
1965	33,261	---	---

1/ Actual cases.

Table 2 compares the California spiced peach pack with that from the other States during the period 1960-64. It can be seen that California's percentage of the total pack is in the range of 80 to 90 percent. By far the most popular container size is the 2-1/2

Table 2. --Spiced peach pack by States

Year	California 1/ Thousands	Other States 1/ Thousands	Total Thousands
1960	701	147	848
1961	509	139	648
1962	578	119	697
1963	378	87	465
1964	497	64	561

1/ Actual cases.

can, comprising about 75 percent of the actual cases over those 5 years. Practically all of the rest of the U. S. pack goes to No. 10 cans, with a very small proportion going into No. 303, No. 300, and No. 1 tall.

Raw Fruit Handling Practices

In California, peaches for pickling are those clingstone peaches which fail to make U. S. No. 1 quality for processing because of size; that is, they have a diameter less than 2-3/8". In all other respects, they must conform to U. S. No. 1 peaches for processing.

In years past, pickers would carry rings in order to gage the diameter of a peach and would not pick the small ones during the time the main pick was taking place. These rings are not in widespread use any more; a good picker can judge by eye whether to leave a peach on the tree. It is common practice now in California for an orchard to be picked twice, with most of the fruit being harvested during the first or main pick. The second pick is essentially a cleanup. The small peaches ultimately destined for pickling are left on the tree until this second pick. The pickles are separated from the No. 1's by passing them over mechanically operated grading screens. This is done by the grower in the orchard. Peaches for pickling are then transported in 1,000-lb. bins to the receiving station where they are graded and certified by a State inspector to be sure that they conform to U. S. No. 1 quality for color, freedom from defects, etc. This third-party grade and certification are mandatory for all California peaches which are to be processed. Clings are graded for incidence of rot, worm damage, color, and invisible split pits. There is a maximum limit for each of these defects, and a maximum of 15 percent for all defects combined. Above 15 percent there is a dockage; above 20 percent total defects, the lot is rejected. In addition to staying within these limits, peaches for pickling must be free of scab and mildew.

The size of the canned clingstone pack in California is governed by the Cling Peach Advisory Board, an organization of canners, growers, and representatives of the State who, based on prior year's sales volume and inventory carryover, establish the size of the cling peach pack. The same considerations apply to the size of the pack going into pickles because the Cling Peach Advisory Board has authority to establish the size of any peach pack that may compete directly against regular canned clingstone peaches in the market place.

Each processor must request the Board for a certain number of tons to be processed as pickles. If the sum total of such requests exceeds the total tonnage allocated for this purpose, then the Board has to make a judgement to determine whether the market will stand the additional tonnage. This has not happened in recent history.

Cling peaches for canning command a price of $55 to 65 per ton at the receiving station. Pickles have traditionally held at a price of $20 ton. Thus, it is evident that there is very little incentive for a grower to go to much trouble to harvest a large crop of pickles.

The pickles are usually those peaches which are found on the inside bottom portion of the tree; this accounts to a large extent for their small size. Moreover, they are generally somewhat less mature on the average than No. 1's. Their raw soluble solids will average 8 to 9 percent; most of the California cling peaches at canning-ripe maturity are 9.5 to 10.5 percent soluble solids. The small size of pickling peaches also means that cullage is higher.

Processing Practices

When the peaches first arrive at the cannery, they are dumped into a tank, from which they are conveyed by an elevator to a grader. This is a vibrating screen. Cull peaches, that is, those less than 1-1/4 inch diameter, are screened out in this operation and go to the gutter. These operations take place in the cannery yard. After grading, peaches are pumped into the cannery to the spooning operation. By "spooning" is meant the loosening of the pit, an action which leaves a suture that permits ready penetration of flavoring and vinegar into the pit cavity of the peach. Spooning used to be done by hand; it is now done by machine. Automatic Filper spooners (also known as punches) will loosen peach pits at a rate of 60 pieces of fruit per minute. We have 18 of these machines in our Oakdale cannery.

After spooning, the fruit is pumped to a lye peeler. The peaches are held in this

peeler for 1 minute at 204° F., with a lye strength of 1.5 to 2 percent. The fruit leaves the peeler and goes through a roller washer. The peach skin is not completely removed in the peeler. The lye exerts a burning action which disintegrates some skin, but peaches are normally removed from the peeler while still retaining some peel; this retained, but loosened, peel is then physically removed by abrasive action of the roller washer. The fruit next moves by conveyor to a grader, which divides it into two sizes, 1-1/2--1-7/8 inch, and 1-7/8--2-1/4 inch diameter. The purpose of the grading operation is to have a more uniformly sized product within a can; packing to a uniform size also helps to control fill weight. After the grader, the peaches go along parallel belts and remain separate through the seaming operation. The next operation after grading is sorting, in which women carefully inspect the peaches for bruises, adhering peel, oxidation, and any other type of physical defect that might detract from the appearance of the finished product. The whole peaches are then filled into cans which have previously received a few pieces of cinnamon bark and clove. After the filler, the cans pass under a vacuum syruper, at which point the syrup containing vinegar and spice oils is added. The use of vinegar in this pack requires packing an extra heavy syrup rather than the conventional syrup for canned peaches in order to achieve the proper sugar-acid balance. By the Standard of Identity for canned peaches, a pack in extra heavy syrup must have a cutout Brix of 24° or above, whereas regular cling peaches are normally packed in heavy syrup, which means a cutout Brix of 19° to 23.9°. The vinegar, which may be 100 grain or 120 grain white vinegar, spice oils, and sugar are mixed together in large tanks before being pumped into the syrup bowl. The sugar used is a blend of 75 percent sucrose and 25 percent corn syrup on a solids basis. Most of the spice flavor in the spiced peaches is contributed by the spice oils, rather than the cinnamon bark and pieces of clove. These latter, although contributing some flavor, are primarily a garnish.

After filling, the cans are seamed, then conveyed on a bar-type elevator to a rotary pressure cooker, where they are processed for 19 to 22 minutes at 224° to 230° F. The exact processing conditions depend on the character of the fruit, since a process in this range is more than enough for sterilization. After heat processing, the cans are cooled to 100° F., then are cased and warehoused.

There are no unusual problems in the processing of spiced peaches. Like any other fruit pack, care must be taken to maintain proper fill weights, and a legally acceptable cutout Brix consistent with the declaration on the panel of the can. Only fruit that is free from blemishes and other forms of defects should be used.

There has been an occasional consumer complaint on spiced peaches, stating that pieces of wood have been found in the can. These, of course, are the pieces of cinnamon bark! It is necessary, because of the vinegar and spice oils, to have a more durable can than is necessary for the other types of canned peaches. Can bodies and ends are made of type L steel, which is a low-alloy steel having limitations primarily on its copper and phosphorus content. In addition to having a less reactive base plate, can ends and bodies are afforded more protection by having twice the weight of tin coating on their interiors than is used for regular canned fruits.

PROCESSING PEACH PRESERVES

by
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The Bama Company, Division of Borden Company
Houston, Tex.

With the theme of this conference being "Peach Processing and Utilization," I presume the emphasis is really on utilization, in order that peach growers will have a better market for their crop.

I look upon peach processing as being a major factor in determining the varieties of peaches that will be grown. We are all interested in those processed peach products that will be most acceptable to the consumer,

and realize that processed peaches include those which are used for remanufacture, as well as those processed directly into products for the ultimate consumer.

Peaches are seldom, if ever, processed directly from the freshly harvested fruit into peach preserves. Originally, canned peaches were the source of fruit processed into peach preserves, however, some years ago frozen peaches entered the market as a new and important fruit material for the manufacture of peach preserves.

At one time, canned clingstone peaches were the largest source of fruit for peach preserves. Later, many preserve manufacturers were using a blend of clingstones and freestones for preserves, resulting in a more acceptable preserve because of the character of the fruit material in the preserve. Clingstone peaches, by their nature, have a more colorful flesh after processing, although a few freestone varieties are attractively colored. Clingstone peaches have a firm flesh and are of such character that the pieces or slices do not take on that "ragged" look after processing, even if somewhat over-ripe.

I believe it can be conceded that many freestone varieties have a more outstanding and more generally accepted flavor than clingstones. It is for this reason that greater quantities of freestone peaches are used in the manufacture of peach preserves than were used in the past. Also, the fact that the preserving industry is no longer dependent upon canned peaches only as a source of fruit. The character of a good quality frozen freestone peach certainly has contributed to its popularity as a source of fruit for peach preserves.

I have tried to get some figures together to give you some idea of the tonnage of peaches used in the manufacture of peach preserves, but have found this to be most elusive and practically impossible, however, the pack of peach preserves in 1964 amounted to approximately 4-2/3 percent of an estimated total production of preserves of 900 million pounds, for those preservers participating in the National Preservers Association program. This would be equal to approximately 42 million pounds of peach preserves.

The National Association of Frozen Food Packers places the 1965 season's pack at 55,562,164 pounds, or about 37 percent less than last year's record pack of approximately 76 million pounds. It was stated that the retail pack of frozen peaches remained about the same and that the entire decline in production took place in the institutional and industrial pack. In this category, the production followed, generally, the traditional distribution by container size with 30-lb. tins retaining its dominant position.

Peach preserves are very popular in the South and Southwestern part of the United States because people in this area are very fond of their flavor, and because they are usually attractively priced. In 1964, The Bama Company produced somewhat in excess of 5 million lb. of peach preserves. This is equivalent to approximately 2-1/2 million pounds of the edible portion of the fruit.

One can readily see that for certain geographical areas, peaches used for the manufacture of peach preserves are no small item when compared with other fruits used in this industry.

Certainly, one must also consider the sales of peach preserves, pricewise, with other popular varieties on the market. Because of the high price of strawberries during the current packing season, this variety is giving way somewhat as the dominant flavor in the market. It can be readily understood that the volume of peach preserves sold in any given area would be reduced, other factors being equal, if peaches were to increase substantially in cost to the preserving industry.

Getting back to the title assigned to this paper, "Processing Peach Preserves," I believe it best to cover this in 3 parts: (1) Types of peaches used, (2) varieties most acceptable for the preserving industry generally, and (3) quality requirements.

1. Types of peaches used in preserving were covered to some degree earlier, it can be said, generally, that freestone peaches are, and have been, gaining in popularity as the type of peach for preserve manufacture.
2. As to varieties most suited for the requirements of the preserving industry,

those peaches having a fine texture, fairly firm flesh, lacking in "rag," having a bright, deep yellow color, having qualities of uniform ripening, and lacking red coloration in the flesh of the fruit, as well as around the pit cavity, are to be desired. It is understood, of course, that the variety must possess an excellent flavor, after processing.

Being only part familiar with some of the many varieties of freestone peaches, I can only presume that some of these varieties may have an excellent flavor in the raw or fresh state and be almost completely lacking in flavor in the final product. This is certainly the case with some varieties of other fruits. Because of the general requirements for variety, it can be said that those closest to meeting these requirements are the Elberta strain, including Elberta, improved Elberta, and Faye Elberta. Many peaches of the Haven varieties are too soft or have too much red coloration in the flesh or around the pit cavity.

The form of the peaches used by preservers has changed over a period of years from the use of canned peach halves to the present use of frozen or canned peach slices. Some preservers are using peaches in diced form. Slices are more generally used.

3. Quality Requirements. Part of the quality requirement was covered in varieties, but more descriptive terms are necessary in covering this subject. Specifications or grades must be used here in order for the peach processor and preserver to have a complete understanding of what is wanted in packing peaches to be made into preserves. I cannot overemphasize the importance of becoming completely familiar with the current U. S. Standards for Grades of Frozen Peaches published by the Processed Products Standardization and Inspection Branch of the Agricultural Marketing Service, United States Department of Agriculture, and using this for your standard, either as a packer or as a user of frozen peaches.

It has been my experience that many packers of frozen peaches have overlooked the possibility of packing a higher quality product with only little more effort, especially for the factor of "Absence of Defects."

If one considers the percent fruit in peach preserves and the increase in volume of the product compared with the volume of peaches used, then it is surely in the best interest of the preserver, as well as the peach processor, to remove the defects at the time of processing rather than have the preserver reject the lot as unacceptable, or to remove the defects from the preserves at the time they are manufactured.

Certainly, the great percentage of preserves are packed and sold in glass containers, and the sales volume is tied directly to the ability of the homemaker to see and choose what she buys.

Since more frozen sliced peaches are used in peach preserves than canned peaches, I have confined my remarks to the frozen product. Generally, frozen sliced peaches for the preserve industry are unblanched, and in order to retain the best color and prevent oxidation during and after packing, the fruit is packed with one part by weight of a 60° Brix (or 66-2/3° Brix) sucrose syrup with each 5 pounds of peaches. The syrup is made to contain about 200 mg. of ascorbic acid for each pound of fruit in the container.

For the frozen, sliced peaches, the 30-pound container is popular for the baking trade, as well as the preserver, but steel drums of the removable head type with polyethylene envelope-type liners are more popular with the preserver because the container cost per unit of net contents is less, and the economy of handling this size container is greater.

We are constantly looking for a better source of quality, sliced, frozen peaches to meet our requirements, and I am sure many preservers join us in this search.

THE SWEETENER IN CANNED PEACHES

by
N. Kelly
Sugar Research Foundation, Inc.
New York, N. Y.

Year after year since its organization in 1943, Sugar Research Foundation, Inc., has devoted substantial parts of its income to studies in food technology. These investigations have covered a broad field, ranging from baked goods through berries, apple sauce, nonsweet foods, canned corn and peas, cranberries, pimientos, and frozen desserts, to mention only a few. The work has also included a number of studies of canned and frozen fruits, among them the product with which this conference is directly concerned--peaches.

I am certain I need not remind anyone in this room that flavor is the most important single factor in all food preference. By that I do not intend to imply that it is the only important factor, but no product having poor flavor, or merely so-so flavor, has survived for long in competition. It is for this reason that most of the Foundation's peach studies have given primary attention to flavor. We wanted to find out how sugar affects the palate appeal of canned peaches, and at what level of sugar usage these products are most preferred by consumers.

Here I speak in the past tense, which is not strictly accurate because our interest in peaches continues actively. Last year, as an example, we had made plans to pack peaches under commercial conditions with a view to determining consumer reactions to canned peaches in which a part of the sugar--sucrose--was replaced by other sweetening agents. Unfortunately, the fruit we intended to use developed pit rot, and it was necessary to suspend the program. However, it has not been abandoned and it may well be included in our schedule for 1966.

Now what have we learned from our studies of canned peaches? It seems to me that the two most significant conclusions to be drawn are these:

First, that consumers generally prefer peaches packed in syrups of higher densities than are usual in commercial practice, and

Second, that consumer preference is not based on the added degree of sweetness but on what consumers describe as "better peach flavor."

The work to which I refer was carried out, for the most part, in the Department of Food Science and Technology at the University of California, Davis, as a part of an extensive investigation of the many factors which influence the quality of canned fruits. It extended over a period of years, and before its conclusion it involved thousands of individual taste responses from laboratory panels, mass samplings, and household surveys.

At the outset of the studies, experts at the University invoked a simple system for testing flavor perception. They sampled solutions of distilled water and varying amounts of sugar, food acids, and imitation fruit flavor. When more flavor or more acid was added to the solution, the panelists had little difficulty in identifying the changes. Yet, curiously, when additional amounts of sugar were used, most judges thought that more fruit flavor had been added, as well as more sugar. There was a point, of course, at which maximum acceptance was reached, and the addition of more sugar was not only detectable but less acceptable.

From these panel evaluations of water solutions, the work moved on to peach nectars in which the sugar content was varied from 1 to 12 percent and the acid from 0 to 1.5 percent. Panelists were asked to answer four questions: Which is the sweetest sample? Which do you like most? Which has the most fruit flavor? Which do you like least? Here there were interesting results. The samples containing 9 percent sugar and 1.5 percent acid were liked best.

In general, the panelists associated preference with the sample they considered most flavorful: Apparent intensity of flavor seemed to depend on the ratio of optimum soluble

solids to optimum acidity. There was a high degree of accuracy in identifying the sweetest sample, and, finally, there was a dislike for the least sweet sample.

With these preliminaries behind us, we turned to canned peaches themselves. In the first survey, canned, diced Fortuna cling peaches were used, the fruit having been harvested from the Marysville district of California. The fruit was immediately taken to the pilot plant of the Department of Food Science and Technology at Davis. There it was sorted, under a standard light source, for defects, size, and maturity (maturity was judged by skin color), and canned under rigidly controlled commercial procedures. Chemical analyses of the raw, peeled fruit were made to determine soluble solids, pH, total acidity, and Brix/acid ratios. Harvesting, sorting, chemical analyses, and canning were performed on the same day. Chemical analyses of the canned fruit were made approximately 30 days later. The cutout readings of the three batches were 17.5°, 21.5°, and 24.2° Brix.

The first consumer tests--mass samplings--were conducted in connection with the Consumer Reaction Council of the California State Fair at Sacramento. The physical arrangements of the tests were based on 20 serving windows in a series. Through each window a different sample of food or beverage was presented to the participants, who were asked to score the product for degree of liking. Since the peaches were served at windows No. 19 and No. 20, each consumer should have tasted 18 other items before reaching the peaches. Thus, the peaches equated with the dessert portion of a meal, and the reactions of consumers to fruit of varying sweetness was considered an indication of dessert quality.

For a critical evaluation of preference, an incomplete block, paired comparison was made. A balanced procedure was followed in presenting three combinations alternately to the participants, so that approximately equal numbers of comparisons were obtained. To offset the natural bias of a preference for the first sample, the order of presentation of each sample was randomized. As a result, virtually equal numbers of participants received the following pairs of samples: 17.5° vs. 21.5°, 21.5° vs. 17.5°, 17.5° vs. 24.2°, 24.2° vs. 17.5°, 21.5° vs. 24.2°, and 24.2° vs. 21.5° Brix. The peaches were served at 40° F., and each participant was asked to state a preference and indicate sex and age group. More than 2,600 individuals participated.

When the results of the tests were tabulated, it was found that the sweetest--24.2° Brix--was preferred, and there was a pronounced tendency to ascribe more flavor to it. However, it was impossible to determine whether the highest sweetness level was the optimum. As a consequence, it was decided to conduct a second survey using canned peaches of a higher and wider range of sweetness.

For the second survey it was impossible to obtain Fortuna peaches because of seasonal variations in growing conditions, and Halfords were used instead. Halfords have organoleptic and canning qualities not unlike Fortunas, and the harvesting, canning, and survey procedures of the first study were followed as closely as possible. Cutouts of the second test were 23.5°, 26.7°, 30.5°, and 34.5° Brix. Here more than 4,000 consumers participated.

The second survey brought to light some interesting contrasts. In the first test, as I have said, there was a decided preference for the sweeter sample in each pair by all age groups and both sexes. However, the second time around, a strong tendency was exhibited among all groups to prefer the less sweet sample. Thus, the investigators concluded that the level of sweetness most acceptable to those who participated at the State Fair was somewhere between 24.2° and 23.5° Brix.

Now I believe it is generally conceded that the reliability of the results obtained in consumer surveys is greatly influenced by techniques and procedures. Among the controversial factors often discussed are the types of approach, that is, mass surveys versus household surveys, and the geographic location of the population studied. Mass surveys have some advantages in that they are quicker, permit better control of tasting variables, and are less expensive than household polls. However, the household survey is preferred by some authorities on the ground that the casual passerby does not make a good judge of food preferences because two abnormal conditions exist: The physical environment is not typical, and most products are consumed simultaneously

with other foods at mealtimes rather than singly.

It is a widely held belief in the food industry that we have in the United States certain regional preferences for food. However, there is little in the literature concerning preferences for foods familiar to consumers in all parts of the country. Thus, our studies entered a third phase--household surveys in which the preferences of a California panel might be compared with preferences in the Midwest.

I shall not attempt to detail the experimental procedures except to say that the fruit--this time of the Johnson variety--was packed under controlled conditions, and that citric acid, at the level of 0.15 percent, was added to one of the three batches. The cutouts were 24.24°, 26.98°, and 27.59° Brix.

In California the household survey was conducted in the town of Woodland, among 225 families. Each family received two coded cans of peaches. Members of the family over the age of 10 tasted the peaches at regular meals and indicated their preference on a score card. The six possible paired sets were distributed randomly and were coded in reverse order in half of the cases to guard against any first sample bias. In the Midwest, peaches from the same pack were distributed by the Kroger Food Foundation of Cincinnati to its Homemakers' Reference Committee, consisting of 750 families, weighted for geographic distribution, income, and age.

What were the results? At the household level both the California group of families and the Kroger committee families demonstrated a significant preference for the sample with a sugar content of 27.6° Brix and acidified to 0.408 percent.

From all these readings it appears that consumer preference in canned cling peaches reaches a peak at a cutout Brix ranging from 24° to 27°--that is, from the high end of "heavy syrup" to the low end of "extra heavy" syrup, as those terms are defined in the regulations of the Food and Drug Administration. Most cling peaches are packed in heavy syrups, which is good--but apparently it's not quite good enough to get the maximum consumer response.

So much for clingstones. Canned freestone peaches are gaining in popularity, but there has been relatively little research to determine the composition of syrups that will give the highest consumer acceptance. To measure some of these unknown quantities, as well as the influence of corn syrup on freestone peach flavor and texture, three packs of Fay Elberta peaches were studied which had these variations in syrup composition:

1. Sugar syrups with cutout levels of 18°, 23°, 27°, and 31° Brix.

2. Sugar syrups with cutouts of 22°, 27°, and 31° Brix, plus 0.1 percent of citric acid.

3. Sugar syrup with corn syrup (DE 54 percent, Baume 43 degrees) substitutions of zero, 20, 30, 40, 50, and 60 percent at cutouts ranging from 22° to 27° Brix.

Again the samples were submitted to a household panel in Woodland, Calif. From 3,043 evaluations came these results:

1. Consumers showed a decided preference for both the flavor and texture of freestones having a cutout Brix of 23°. Sweeter samples were also well liked, and the lowest level of sweetness was considered poorest in flavor and texture.

2. The addition of acid did not improve flavor, even in the very sweet samples, nor did it affect texture. Thus, the results differed from the consumer tests of cling peaches.

3. The all-sugar control having a cutout Brix of 23° was preferred in both flavor and texture to the corn syrup samples. A laboratory panel found that fruit packed in cutout syrups of 22° to 23° Brix--the range of maximum acceptance--definitely decreased in flavor with increasing amounts of corn syrup.

Finally, let me say we're convinced that the thousands of consumers who have expressed their preferences in these many tests can't be wrong--that higher sugar levels than are now being used commercially give better flavored products and more acceptable canned fruits.

Experts at the University of California summed it up this way: "We've found that

people prefer their peaches sweeter than was currently believed by the packers, and they did so consistently from year to year. The addition of citric acid to the fruit shifted consumer preference to a higher sugar level and resulted in a product with more zest and character."

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PREPARED PEACH BABY FOODS

by
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There is a tremendous demand upon Gerber to supply specially prepared peaches as a food for babies and young children. Because of this demand and because we wish not only to maintain, but improve the overall quality of our pack, we continue to seek more adaptable varieties and better production methods. This paper is given to outline the procedures followed at a given plant--Asheville.

Over the years, Gerber has worked extensively in testing and aiding the development of peach varieties, particularly of clingstone type in several geographic locations. The clingstone varieties are attractive for several reasons, but mainly for the bright peachlike color of the puree. In general, clingstones store better than freestones and flesh is nonmelting, yielding thicker consistency and better usage. In the Southeast, emphasis has been placed in the Spartanburg area in testing of the Baby Gold variety, which was developed at Rutgers University by Fred Hough and Catherine Bailey. Baby Gold has been particularly rewarding because of the excellent final color combined with pleasing flavor. Additionally, the fruit is large, the pit is relatively small, and the various sub-varieties of Baby Gold bear heavily and mature progressively through the season, allowing our pack to be conveniently spaced. Baby Gold is not yet our major variety used. Several

plantings of Amber Gem from this same area are producing very well, and our packs are mainly composed of Amber Gems and Baby Gold in blend with local existing freestone peaches such as Sullivan, Elberta, and Southland. Later in the season we use some Amber Gems from Virginia.

During the short crop season of 1964 which was seriously affected by late frost, we used some freestone peaches from Georgia. Still falling short, we received several carloads of cooled whole peaches from California. These were all clingstone varieties. This California test was most successful--losses were low, and we were able to produce the bulk of our finished goods requirements.

Although our produce department contracts our peach requirements just before harvests, they work closely with the growers during development of the crop, especially in the areas of insect and fungus control. Using the latest information from company research, county agents, colleges, and other agencies, a routine safe spray schedule is developed with the grower to help assure delivery of the first-class produce.

On arrival at the plant, the purchased peaches are weighed, tagged according to grower, variety, and arrival time, and placed in 30°F. storage.

At time of actual manufacture, the 20-bushel pallet boxes of peaches are moved by lift truck to the bulk hoppers from which the peaches start their movement through the various pieces of processing equipment. Care is taken at the beginning to see that the recommended blend for the day is maintained. All surfaces of equipment which actually come in contact with peaches are made of stainless steel or rubber belting.

We employ two types of pit-removal techniques. One is a Gerber developed mechanical pitter which punches pits longitudinally through peaches placed manually on hard rubber cups containing a hole just large enough to accept the pit and hold back the fruit. Additionally, we are working on a method using specially constructed pulpers or finishers that remove the pit from the cooked whole peaches, which bypassed the mechanical pitters.

All peaches are lye peeled to insure no specky interference in finished product from highly colored skins and to effect complete removal of all spray residues. After peeling and pitting, plus several washings, the peaches are inspected and trimmed by women from a continuous belt. Finally, prepared peaches are conveyed through the screw-steamer where they are rapidly and fully cooked in the flowing steam, inactivating enzymes, and retaining maximum color. Emerging peaches are passed through a series of finishers to remove remaining pits and other waste and to reduce the peach to final particle size required in puree.

Hot puree is pumped to the batch tanks where sugar is added at correct rate to maintain balance with acid content. The batch is then heated to proper temperature and adjusted to correct volume and consistency and pumped to a holding tank where continuous blending takes place and surge condition is maintained for flash heating.

The highly acid product is sterilized by heating in one of the three types of heat exchangers to above boiling and held at this temperature under pressure in the product pipeline. The sterilized product discharges into the vacuum deaerator where practically all occluded air is removed and product temperature is reduced to the desired fill temperature.

At the filler, prewashed jars are filled within very narrow limits to insure adequate fill with minimum waste due to overfills. The hot filled jars pass to the capper where jar headspace is steam evacuated immediately before twist caps are applied. The still hot completed packages are conveyed to a sterilizer cooler which is a combination heating and cooling unit. The jars are carried on a belt through a steam heated section then gradually cooled by water spray so that when they exit from the unit they are sufficiently cool to pass immediately to labeling. This hot hold assures internal sterilization of the container, as well as maintains previously sterilized product.

The cool jars arrive by conveyor to the labeling operation where they are washed, polished, dried, and labeled, cased, and taken by lift truck to warehouse for storage. Great care is taken to see that correct label

is applied neatly and securely to a clean jar. All case identification must be clearly and neatly printed.

Glass handling is a major part of our operation and has actually become an art as line speeds increase. Mechanical setups, glass jar coatings, minimum temperature variation, and tight pressure control are some of the factors required to assure smooth transfer of glass through all phases of operation with minimum breakage.

Our quality achievement is a result of combined efforts of many individuals and departments, beginning with produce procurement continuing through production operation and ending with storage and shipping.

Our quality control group is responsible to see that quality standards are being maintained at all points of manufacture. Technicians and technologists are continually checking food and packaging materials using the latest organoleptic, chemical, microphysical, and microbiological techniques available.

DISCUSSION

Question: I would like to ask Mr. Johnson if he uses frozen peaches put up with dry sugar only instead of the syrup one plus five of dry sugar?

Mr. Johnson: No.

Question: Some reason for this?

Mr. Johnson: Well, yes. There is a reason for it because when you are packing peaches with dry sugar, there is much more chance of incorporating air in the product. Of course, with unblanched fruit, with the incorporation of air, you run a great deal more danger of oxidation, coloration.

Question: I'd like to ask Mr. Johnson if anybody has offered him any frozen flakes?

Mr. Johnson: Yes, we tried some of those experimentally. I understand that some are still being used experimentally. I don't know just how many. Our experience was that they were apparently underripe and it was about like trying to preserve pieces of rubber.

Question: You mean the fruit originally used was not ripe enough?

Mr. Johnson: That is right.

Question: Is it your feeling if it was ripe enough, it would have been an adequate product?

Mr. Johnson: There is a possibility, yes. I haven't pursued it quite far enough yet.

Question: I would like to ask about the operation, after you go through the Langsenkamp for removing pits; did you use a finish screen in that?

Mr. Fisk: After the pit removal of the Langsenkamp? That is a stream there. We use two finishers after that.

FIFTH SESSION

FRESH PEACH PRODUCTS

Chairman, J. W. Edwards, Besco Products Company, Zebulon, Ga.

PROCESS FOR PASTEURIZED REFRIGERATED PEACHES

by
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Auburn University, Auburn
(Presented by H. Harris)

Pasteurized refrigerated peaches are a product different from canned or frozen peaches. The new process, developed at Auburn University by researchers of the

Alabama Agricultural Experiment Station, preserves the high qualities of fresh, ripe peaches for a long period in packaged ready-to-serve form. This process involves use of a carefully controlled pasteurization treatment, addition of vitamin C and citric acid to pack, vacuum sealing, and refrigerated (32° to 34° F.) storage. Samples have been held with little change in qualities during 30 months' storage.

The pasteurization treatment, which eliminates the need for chemical preservative, is the key to the high quality and long shelf life of the product. A special machine has been designed and a laboratory model constructed to rotate the container of peaches during pasteurization and cooling. This provides the necessary control of heating throughout the container and greatly reduces the time required for heating, cooling, and chilling.

Research on pasteurized refrigerated peaches was begun in the Department of Horticulture at Auburn in 1960. Reports on progress of the research were made at the Association of Southern Agricultural Workers (ASAW) meeting, Memphis, Tenn., February 1963 (1); in "Highlights of Agricultural Research," Summer 1963 (2); in USDA "Food and Home Notes," June 1963 (3); Journal of American Dietetic Association, October 1963 (4); and in several news media. This research also has been reported, and products displayed at a number of conferences and meetings, and television programs. At the ASAW meetings in Dallas, Tex., February 1965, an additional report was made on the pasteurized refrigerated peach research. It was concerned with studies in 1963 and 1964 on varieties of peaches, methods, equipment, pilot-plant operations, and market acceptance of the product.

Technology of making pasteurized refrigerated peaches is presented here for use by commercial people and others who may be interested. Processors who are already in the business of packing canned or frozen peaches may use much of their present equipment and facilities in processing pasteurized refrigerated peaches. Standard freestone peach pitting and peeling lines can be used with minor alterations or adjustments in the preparation of slices for the pasteurized refrigerated product. Certain other equipment and facilities in peach canning or freezing operations may also be used. Individual processors will need to study available facilities to determine uses that can be made of present equipment and additional equipment needed to carry out the operations as outlined here.

1. Source of fruit. Quality of the product can be no better than that of the fruit from which it is made. Only good processing varieties should be used. The fruit should be allowed to ripen on the tree as much as is feasible.

2. Post-harvest ripening. For highest quality, peaches should be ripened to the early soft stage or as ripe as is consistent with production of well shaped slices without undue losses from over-ripening. Standard practices used in ripening peaches for canning or freezing may be used. Dipping the fruit for 5 minutes in water at 125°F. will help control brown rot if this becomes a problem. The length of ripening period after harvesting will vary with variety and other factors.

3. Inspection. Peaches going on the processing line should first pass over an inspection belt for removal and return for further ripening of fruit that is too firm, and also for removal of culls.

4. Pitting. Freestone peach pitters are suggested for the pitting operation. A worker should pit approximately 12 bushels of 2-1/4" fruit per hour on this machine. The rate increases with larger fruit and decreases with smaller fruit.

5. Pit Separator. Shakers are available for separating pits from halves.

6. Lye peeling and washing. The successive treatments of turning halves as needed, inspecting, preheating, applying chemical, holding, and washing may be done on a continuous line. Some varieties of peaches have a large amount of red pigments in the pit cavity, which may cause reddishness in the finished product. Much of this pigment can be removed by treating the pit cavity with lye during peeling. However, if the pit cavity is to be treated, it will be necessary to determine the alterations or adjustments needed, if any, in applying the chemical with the particular peeler to be used. Also, it will be necessary for the pit cavity to be thoroughly sprayed during washing.

7. Treating with citric acid -SO_2 solution. Treating peeled, washed peaches in a solution of 0.05 percent each of citric acid and sodium meta bisulphite has proved beneficial in reducing greenishness and reddishness in the flesh and in decreasing oxidation during further processing and storage. This solution can be recirculated and reused for a long period by replenishing chemicals as needed. A final rinsing in tap water removes all SO_2 residue detectable by taste. For best results, this solution should be sprayed on the halves immediately after lye peeling and washing, and prepared slices should be held in the solution for a second treatment of approximately 3 minutes prior to pasteurization.

8. Inspection of halves. The peeled, washed, chemically treated halves should pass over an inspection belt for any necessary hand trimming before slicing.

9. Slicing. Standard peach slicers may be used. More uniform size of slices may be obtained if peaches are graded and processed by sizes. Hand slicing may also be considered. If this method is used, different sizes may be processed together, and the number of slices from a half varied with the size of halves. Hand slicing may be combined with inspection and trimming of halves as covered under operation number 8.

10. Grading slices. Machine-sliced peaches should be graded to remove "slivers."

11. Chemical treatment of prepared slices. The prepared, graded slices should be held for 3 minutes in citric acid -SO_2 solution as specified. This operation requires a holding tank with suitable conveyor system to move fruit at a uniform rate through the solution. An alternate method is to hold washed halves in the chemicals for 5 minutes instead of the spray treatment in operation number 7, and eliminate treatment of slices.

12. Rinsing and pre-heating slices. Regardless of the method used to treat fruit, slices should be rinsed to remove chemical residue. They should also be pre-heated before packaging. To accomplish these operations, slices should be rinsed with warm water (150°F.) and steamed for 30 seconds (212°F.). The rinsed, pre-heated slices are ready for packaging. If the chemical-holding treatment is to be applied to prepared slices instead of halves, operations numbers 11 and 12 may be done in a single continuous unit equipped with a draper conveyor system. A special machine of the type used in the Horticulture Processing Laboratory at Auburn is suitable for such operations.

13. Jar and syruping line. The jars are uncased and fed to a line where they are cleaned, pre-heated, syruped, and acids added. The sugar syrup is prepared in steam-jacketed kettles or other suitable equipment where it is heated for 10 minutes at approximately 210°F. The Brix is adjusted to 72 percent, and the syrup pumped to a holding tank where the temperature is maintained at approximately 200°F. while being used. The syrup is added to the jars at the rate of 2.5 fluid ounces per pint jar. This will provide enough sugar for 1:5.3 ratio of dry sugar to fruit slices. However, this volume of syrup will not completely cover the slices. Water at 200°F. is added in operation number 14 to finish the fill after slices are added. An alternate syruping method is to use 3 fluid ounces of 63° Brix syrup per pint jar and eliminate the use of hot water.

Standard syruping machines are available for in-line syruping operations. Between syruping and addition of slices, ascorbic acid and citric acid are added to the jars at rates amounting to 0.013 and 0.010 percent, respectively, of the net weight of the pack (fruit and syrup). Special dispensers are available for this operation. The jar and syruping line are timed to supply the pre-heated, syruped jars to the slice-filling operation, operation number 14, as needed.

14. Adding slices to jars. The slices are added at the rate of approximately 0.85 lb. per pint jar. This operation may be mechanized, but until further developments are made, at least some handwork will be required. What appears to be a satisfactory semimechanical filling machine is a unit that will proportion the slices in bulk quantities for jars and feed them to a vibrating V-shaped trough. The vibration and shape of the trough will cause slices to line up and flow endwise into jars. Handwork may be needed to feed jars to the troughs and press top slices down to provide correct headspace. Peach slice

filling techniques used in canning plants may also be adapted to filling of the jars in making pasteurized refrigerated peaches.

15. Closing. Machines are available for steam vacuum closure of jars. These should be adjusted to provide not less than 17 inches of vacuum on containers after cooling.

16. Pasteurizing-cooling. The packaged product should be heated to a center-of-jar temperature of 160° F. and cooled to at least 50° F. before casing. It is essential that heating be rapid and uniform. Tests on the laboratory unit developed at Auburn for roll heating of the jars indicate that approximately 4 minutes are required for this pasteurization treatment with jars in steam at 212° F. and rotating at 50 r. p. m. A holding period of 2 minutes with continued rotation but without steam is recommended for equalization of heat in the jar before cooling.

Different methods may be used for cooling the product. Cooling by spraying jars with water has proved to be a satisfactory method. This may be done with jars rotating as in the pasteurization operation or with jars stationary and standing upright. At all stages of cooling, the temperature of water should not be lower than 60° F. below the temperature of the jar surface. However, jars can be tempered within a short time to take 35° F. water without undue shock.

For fastest cooling, jars should be rotated as in heating, and moved into 35° F. cooling water as fast as possible without undue shock. Under these conditions the product will cool and chill to a center-of-jar temperature of 50° F. in approximately 20 minutes' time. This compares with approximately 40 minutes required under similar conditions but without rotation of jars.

A special jar roll-type pasteurizer-cooler has been designed at Auburn for continuously heating, cooling, and chilling products in glass jars. A prototype model of this machine has been constructed and tested.

17. Drying. Excess water should be removed from jars before casing.

18. Casing. Machines are available for the casing operation. Casing also may be done by hand if volume of output is not great enough to justify the use of a machine.

19. Storage. The product should be held at 32°-34° F. until marketed. Short periods at temperatures up to 45° F. do not seem to harm the product.

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REFRIGERATED FRESH SLICED PEACHES

by
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Georgia Experiment Station, Experiment

One of the most recent developments in the fruit and vegetable industry is the marketing of fully prepared "ready-to-serve" or "ready-to-cook" fresh products. Outstanding examples are fresh citrus sections, pineapple slices, melon sections, peeled carrots, peeled potatoes, and prepared fresh fruits or vegetables for salads.

While refrigeration, just above freezing is the chief preservative, sweeteners, antioxidants, microbial inhibitors, and acidulants are frequently used.

Fresh peach slices were found particularly difficult to preserve because (1) they oxidize and turn brown readily; (2) the texture

is delicate and difficult to maintain; (3) the fresh aromas and flavors are "mild" or "bland" compared to other fruits, they are volatile and also easily lost through chemical changes; (4) peaches for slicing must be freestone which amount to less than half the varieties grown in the Southeast; and (5) the freestone varieties vary widely in color, flavor, and texture, making it difficult to maintain uniform quality.

The purpose of this study was to attempt to develop procedures for the preparation and handling of refrigerated fresh sliced peaches.

Review of Literature

A review of literature revealed that considerable research had been reported on the preservation of chilled citrus sections, as related to method of preservation, including kind and amounts of preservatives, the influence of storage temperature, and kind and amounts of sweetening agents studied.

The work reported on refrigerated fresh sliced peaches is less numerous.

Robinson and Hills (3) stated that a combination of sodium sorbate (0.06 to 0.12 percent) and mild heat (120°F. for 5 minutes) greatly increased the storage life of apple cider, peach slices, and fruit salad. In the presence of 0.06 percent sodium sorbate, a heat treatment as mild as 100°F. for 5 minutes destroyed more than 50 percent of the initial yeast, mold, and bacteria in cider and increased the storage life to 14 days at room temperature. At 120° there was a 99 percent reduction in microbial counts, and the storage life was increased to 23 days at 70°F. Similar results were obtained with peach slices and fruit salad.

Harris (1) reported successful preparation of refrigerated pasteurized peach slices. This method of processing is based on carefully controlled pasteurization treatment, and refrigerated (32° to 34° F.) storage. This process was designed to retain a high quality product for a long period in packaged ready-to-serve form. Samples prepared by this method in 1960 rated excellent in color, flavor, and texture after 48 months of storage at 32° to 34°F.

Van Blaricom (4) reported a procedure for the preparation of sliced, ripe, freestone peaches as a fresh refrigerated product. Ripe peaches were peeled, pitted, sliced, placed in glass containers, and covered with a light syrup. The composition of the syrup was: sugar 25 percent, ascorbic acid 0.05-0.07 percent, citric acid 0.05 percent, sodium benzoate 0.05 percent, and sodium bisulfite 0.0165 percent. The sulfur dioxide content should be held at 30 p.p.m. or less, and the temperature held at about 30°F. As they remained in storage beyond 2 months, an almondlike flavor gradually developed.

Procedure

The peaches, more than 2 dozen varieties and selections, were obtained from the Department of Horticulture, Horticultural Field Station, Fort Valley, and commercial growers. They were graded to a uniform degree of ripeness, lye peeled, pitted, halved, quartered, or sliced, and packed in straight wall glass jars, or plastic bags, and covered with syrup. Antimicrobial agents, including sodium benzoate, diethylpyrocarbonate, sulfur dioxide, and potassium sorbate, with and without mild heat (120°F.) and with and without vacuum were studied. Antioxidants tried included ascorbic acid and dextrose mixtures, ascorbic and citric acid mixtures, isoascorbic and citric acid mixture in amounts recommended for frozen peaches, water emulsion of butylated hydroxyanisole, oxygen acceptor enzyme (Fermcozyme), and peroxidase inhibitor in concentrations up to 0.1 percent. Firming agents studied were calcium chloride and calcium citrate at 0.1 percent levels. Many of these were used singly and in combinations.

Sweetening agents used were sucrose in concentrations ranging from 10 to 70 percent; regular, and high maltose corn syrup in 25 to 40 percent concentrations. The chemical preservatives were incorporated in the syrups for covering the peaches. A storage temperature of 32° F. was generally used; however, 40°, 50°, 60°, and 70° were used for comparative purposes and for accelerated tests. Examinations were made at regular intervals for changes in color, appearance, aroma, texture, and flavor, and microbial spoilage. One variety--Redskin--was evaluated by Colonial Stores Home Economics Department at the same time companion samples were evaluated by the Food Science Department.

In 1964 and 1965, commercial packs of refrigerated fresh sliced peaches were macro-market tested through major supermarket chains.

Results

Results showed that fresh, prime ripe peaches had a "mild" or "bland" flavor compared to most other fruits. This delicate flavor was easily lost, or masked by additives, or changed to an undesirable "bitter," or almondlike flavor through enzymatic action. In general, the color and appearance were retained in excellent condition for 4 to 6 weeks, and in good condition for longer than 12 months. Detectable changes were noted in texture and flavor after around 6 weeks of storage. Continual softening and increasing "bitterness" indicated that the ripening process was continuing. Though changes were apparent to trained tasters, peach slices retained a marketable shelf life for about 10 to 12 weeks.

Results further showed that (1) ascorbic acid preserved the color of refrigerated peach slices better than an oxygen-acceptor enzyme, peroxidase inhibitor or water emulsion of butylated hydroxyanisole; (2) potassium sorbate and sodium benzoate increased the storage life more than fivefold; (3) heating slices to 120°F. for 5 minutes more than doubled the shelf life at 70°F.; (4) under the conditions of these experiments there appeared to be no particular advantage when peach slices were packed under 20 inches of vacuum; (5) none of these treatments prevented or retarded the continual softening which eventually resulted in a soft texture and ragged appearance of the slices; (6) mild heat (120°F. for 5 minutes) retarded, but did not prevent the development of a bitter flavor (almondlike); and (7) syrups with a soluble solids content more than 15 percent above that of the slices caused excessive shrinkage and floating in the jars.

The optimum syrup concentration varied with variety and degree of ripeness of peaches, and ranged between 20° and 35° Brix.

Corn syrup, dextrose, or calcium cyclamate may be used to replace up to 50 percent of the sucrose without noticeably changing the quality of peach slices. Also liquid sugar may be used for all the syrup.

The use of a vacuum process similar to that described by Guadagni (2) for apple slices to induce syrup penetration, (1) completely retarded fermentation, (2) reduced the fresh peach aroma, and (3) drastically changed the appearance of the slices.

After 4 years and many experiments with more than 30 varieties, numerous combinations of chemical preservatives and several processing techniques, it was concluded that the most important factors involved in the preparation and preservation of refrigerated fresh peach slices include:

1. Careful selection, handling, and preparation of the fruit. Medium size, high quality, fully and uniformly ripened firm freestone peaches free from defects and disease gave consistent results. Prime maturity can best be described as "table-ripe," but not to the softening stage from which peaches deteriorate with increasing rapidity. Uniformity of maturity and size is important in producing a uniform quality pack. Medium size fruit is preferred. Too large fruit gives an unattractive pack, and too small fruit is expensive to process and may have a bitter flavor. The peeled and sliced fruit should be promptly covered with syrup containing ascorbic acid to prevent browning, organic acids (citric or malic) to improve taste, and a chemical preservative.

2. Rapid and thorough chilling to 34°F., and storing at 30° to 32° is essential, since a large part of the preservation depends upon providing an unfavorable environment for the growth of micro-organisms.

3. A very strict and rigid plant sanitation program must be constantly maintained to keep microbial contamination low. All equipment that peeled and sliced peaches come in contact with must be absolutely clean, and chlorinated frequently, since this product is not heat processed nor frozen.

4. A conscientious quality control and inspection program must be followed to assure an attractive, high quality uniform pack with good customer appeal and shelf life.

In 1964, a commercial citrus sectionizing plant in Florida, packed over 12,500 cases (basis 12/26 oz.) of refrigerated fresh peach slices which were distributed through

major supermarket chains in Florida, Georgia, Alabama, South Carolina, Kentucky, Ohio, New Jersey, Pennsylvania, California, and Washington, D. C. This product was not given in store displays, demonstrations, or backup advertising. They were sold at $4.50 to $5.00 per case, f.o.b. Florida, and retailed at 69¢ per jar. Repeat sales were made to retailers in every market in which the product was introduced. They were all sold out in 6 to 7 weeks.

In 1965, this same plant expanded production to well over 100,000 cases, which were again sold out within a very short time. This further illustrates the consumer acceptability of refrigerated fresh peach slices.

Steps in Commercial Preparation of Refrigerated Fresh Peach Slices

1. Receive peaches harvested in the ripe, but firm stage. The prime ripe fruit is processed immediately or held under refrigeration; unripe fruit is held to ripen properly. Over-ripe fruit should be avoided since slices become ragged and soften rapidly.

2. Grade fruit for size and freedom from defects. Use roller grader for hand removal of unsuitable fruit.

3. Peel by immersing in, or spraying with, 5 percent lye at 210°F. for 30 seconds, or until peel is loosened.

4. Wash with rotary or spray washer, using ample water to rapidly remove lye and loosened peel.

5. Pass fruit through brush washer with soft brushes to completely remove peel and diseased spots.

6. Collect peeled fruit in water containing 0.5 percent citric acid, 0.15 percent ascorbic acid, and 0.5 percent sodium benzoate. This is to neutralize traces of lye and retard darkening and fermentation.

7. Pit and slice the peaches by hand or machine.

8. Preheat or sterilize jars with steam.

9. Mechanically add 1.1 oz. of liquid sugar at 72 percent soluble solids to each sterile 26-oz. straight walled jar.

10. Pack by hand 22 oz. of peach slices, which have been carefully graded for uniformity of color, size, and symmetry. This is to assure an attractive uniform pack. A most attractive pack is attained when slices are placed vertically with the cut edge toward wall of jar.

11. Cover slices with 2.9 oz. of water containing 0.893 percent ascorbic acid and 0.633 percent sodium benzoate. NOTE: Instead of steps 9 and 11, peaches may be packed in jars covered with 4 oz. of 30 percent soluble solids syrup containing 0.75 percent ascorbic acid, and 0.47 percent sodium benzoate.

12. Close jars with steam jet capping machine.

13. Chill jars rapidly to 32° to 34°F. with water spray or circulated water.

14. Dry off cooling water.

15. Case, and invert for mixing contents.

16. Store and merchandise at 30° to 32°F. for as long as 12 weeks.

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FREEZE DRYING PEACHES

by
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(No copy of this paper is available for publication.)

EVALUATION OF PEACHES FOR PROCESSING

by
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(Presented by G. R. DiMarco)

In the Department of Horticulture and Forestry at Rutgers a genetic bank of several hundred varieties and selections of peaches and nectarines have been developed which are suitable for cultivation in the Eastern United States.

Because this large selection of raw material was available, the Department of Food Science, in cooperation with the Department of Horticulture and Forestry and the U. S. Department of Agriculture, initiated a project to select newly developed varieties of peaches suitable for commercial processing and to determine, if possible, the influence of chemical and physical properties of the fresh fruit on processing quality. The latter objective was initiated with the peach breeder in mind. Since a breeder must make important judgments on a very limited number of fruit early in a breeding program, a positive correlation of some factor or factors, measured objectively, with processing quality could be an important tool for him.

The project has been in existence for the past 3 years. To date we have conducted analyses on fresh peaches (with both freestone and nonmelting clingstone) and nectarines for possible correlation with processed quality. A total of 61 clingstone peach, 46 freestone peach, and 25 nectarine selections or varieties were evaluated for processing potential. Analyses conducted were as follows:

pH total acidity, soluble solids, texture (shear-press), color (Gardner Color-Difference Meter), color (Color Dictionary), carotene (provitamin A), ascorbic acid.

Fruit were then canned and frozen. These same analyses, except for the vitamins, were also conducted 5 days after canning. Four to 6 months after canning or freezing the samples were again analyzed as per the raw fruit schedule. In addition, sensory evaluation was conducted to determine flavor difference, flavor preference, and texture preference of the test sample versus one of known high quality.

The canning procedure was as close to a commercial operation as facilities allowed, which was briefly as follows: Sort and wash, halve and pit, lye peel (2 percent NaOH), tank wash, spray wash, steam heat, fill (constant weight) into No. 2 peach cans, add hot syrup, seal, process at 212° F. for 25 minutes, cool, and store.

Perhaps the most significant departure from a commercial procedure was the sugar concentration used in the syrup. Early in our work our flavor panelists complained of "excessive" sweetness which hampered their ability to detect real flavor differences, so we reduced the syrup from 40 to 35 percent sugar.

The freezing procedure was modified from the standard industrial procedure primarily to accommodate ascorbic acid analysis. Briefly, the procedure was as follows: Wash and sort, halve and pit, lye

peel (2 percent NaOH), tank wash, spray wash, hand slice, fill into No. 2 peach cans, add previously boiled and cooled syrup, pull vacuum (15 in.), seal, and blast freeze at -15 F. This procedure was very satisfactory, producing a product with no significant amount of browning, even though no ascorbate was added as is usual in commercial practice.

The varieties and selections processed were selected by the Department of Horticulture and Forestry. Fruit was picked approximately 3 days before they were fully tree ripe. Fruit was ripened to the desired stage at 70° F. prior to analysis and processing.

Varieties showing the greatest promise in a given year were processed after two different picking dates the following year for a comparison of picking condition effect. In this case picking times were approximately 3 days and 7 days prior to being fully tree ripe.

As indicated earlier, ideally, the analyses of the fresh fruit would enable us to predict the canned or frozen fruit quality. In practice, however, this has not been possible, using the procedures followed in our laboratory.

Ultimately, the flavor panel evaluation has been the single most important criterion for evaluating quality, although other values, such as color, pH, soluble solids, and vitamin content, definitely play a role in the overall product quality. We have not given up this search as yet. As you can imagine, we have accumulated a mass of data in the past 3 years on this project. In our search for meaningful correlations between the fresh and processed fruit, simple correlation coefficients were calculated using an IBM 7040 Computor.

From the data gathered to date, however, it does appear that we can predict from the raw fruit analyses the processed value (not overall quality) of a number of these quality factors. Correlation analyses of fresh versus canned and fresh versus frozen analytical data were significant at the 5 percent level or less for several factors studied relative to itself, e.g. pH of fresh versus pH of canned product.

Very few raw fruit analyses could reliably be used to predict the value of a different analyzed quality factor after processing. Two notable exceptions to this were fresh pH versus processed total acidity (and vice versa) and fresh ascorbate content versus processed carotene content.

The former is to be expected since pH is a function of total acidity. The latter, however, was somewhat surprising, especially since it held true only for the clingstone peaches tested and not for the freestones. (Very high correlation for clingstones--some correlation for freestones.)

Vitamin C content of our fresh samples showed a number of varieties to contain two to three times the average values found in the literature. Literature values show 7 to 8 mg./100 g., and some of our test samples showed up to 25 mg./100 g. While our canned fruit had 2 to 3 mg./100 g. higher than those reported in the literature, the frozen samples were considerably lower in vitamin C content than that reported. Our samples gave smaller values after freezing and storage by as much as 50 percent, while the literature indicates an increase in vitamin C after freezing and storage.

Provitamin A or carotene content of our fresh samples varied considerably with several samples having an unusually high content. Frozen samples after storage had carotene concentrations generally comparable to the fresh, while canned samples generally showed a marked increase in carotene content. This phenomena has been reported for some vegetables in the literature by other workers, but they give no explanation for it. One explanation we are experimenting with now is that the change in carotene concentration is a function of a change in product tissue mass or density which occurs after processing, due to the osmotic pressure set up outside the tissue.

No correlation could be made between the panel texture preference ratings and those obtained with the shear-press. Differences in firmness of peaches, however, such as the unusual firmness of the frozen clings after thawing were clearly indicated by shear-press readings.

The influence of picking time (3 days versus 7 days) varied considerably from one

variety to another, but was consistent for a given variety. The peaches picked 7 days prior to being fully ripe generally produced a canned product equal to or slightly poorer, in flavor and/or texture than its 3-day counterpart. Differences were slightly more noticeable in the frozen product.

The most promising processing varieties selected are presented in tables 1, 2, and 3 for clingstones, freestones, and nectarines, respectively, Also listed are a few varieties which, although they are not very promising as commercial processing stock, do have other attributes of special interest.

Nonmelting Clingstone Peaches

The nonmelting clingstone peach varieties have been used almost exclusively for canning by industry. Thus, the test varieties and selections of nonmelting clingstones have been considered in this light (table 1). However, two selections, 554291 and 561997, were quite good in both flavor and texture as a frozen product. This is not meant to suggest that they would be acceptable as a frozen product at the present, but certainly does indicate that a clingstone frozen pack might be developed. Further, it is suggested that, with proper selection of clingstone varieties and freezing methods, the clingstone frozen pack could be superior to frozen freestones for two reasons. First, when frozen clingstones are thawed for use, many of the selections were much less subject to enzymatic browning. Note: No ascorbic acid was added to either frozen pack. Second, because of the firmness of clingstone peaches, they do not become mushy and lose their desirable texture.

The overall high quality of the Babygold series of nonmelting clingstone peaches was indicated in the first year's results from this project. This information was accepted enthusiastically by several commercial processors and a whole new industry has been initiated in eastern North America--over 2 million trees of the Babygold varieties have been planted.

In western Michigan and in the Shenandoah Valley of Virginia, they are to be canned as halves. In southern Ontario, Arkansas, and the Carolinas, they will be used for puree at present.

The Babygold 5-9 series gives a relatively long harvest and processing season (3-1/2 weeks), and it is felt that this season will be lengthened by the possible addition of Babygolds 2, 3, and 4. For this purpose some of the early ripening NJC selections are being considered because of their close quality similarity to the already named Babygolds.

Ambergem, the only clingstone previously grown in the East, competes directly with Babygold 6 but was judged to have slightly poorer flavor and texture. In addition, the excessive red at the pit area can cause a processing problem.

Dixon 1, a new California variety, was judged to be in the quality range of Babygold 8 and 9 but it is not well adapted to growing conditions in the East.

While our tests indicated that the selection NJC 22 was slightly poorer in flavor than the Babygolds, it was included in the table primarily because of the interest shown by the Raw Products Research Committee of the National Canners Association. It was considered a good quality canned peach and competes directly with Babygold 6 and Ambergem in season of ripening.

Selection 540467 was included in the table due to its unusually high contents of vitamin C and provitamin A (relative to other samples by the method used) and because of its good horticultural characters as well.

The only peach judged better in canned flavor than the Babygolds by the flavor panel was the selection 561994 A. This selection was also judged superior by the Raw Products Committee. The unusual nutlike flavor, however, was so different that it must be considered a "specialty type" rather than a commercial "prototype" for the present.

Freestone Peaches

Superior processing quality would make a new freestone variety more versatile and, therefore, likely to be more widely planted. With a perceptible trend and a real concern throughout the eastern peach-growing industry for the utilization of more and more freestones for processing, it is important to recognize superior processing qualities in

Table 1. --Horticultural and processing characteristics of certain nonmelting clingstone varieties and selections

Variety or selection	Weeks ripe from Elberta	Size (in.)	Flesh color [1/]	Red at pit [2/]	Remarks [3/]
NJC 70	-5-1/2	2-1/4-1/2	YO	0	Earliest ripening; slightly poorer quality but similar to Babygolds.
NJC 72	-4-1/2	2-1/2	YO	0	Earliest clingstone comparable to Babygolds.
NJC 74	-4	2-1/2	YO	0	Not quite as good as Babygolds 5, 6, and 7.
540467	-3-1/2	2-1/2	Y	0	Clear yellow flesh and skin; quality poorer than Babygolds but high vitamin C and pro-vitamin A content.
NJC 75	-3-1/2	2-1/2	Y	0	Not quite as good as Babygolds 5, 6, and 7.
Babygold 5	-2-1/2	2-1/2-3/4	Y	1-	Very good quality.
554291	-2-1/2	2-3/8	OY	0	Fresh fruit crisp; frozen flavor and texture better than Babygolds, browns quite rapidly.
561997	-2-1/2	2-3/8	O	0	Orange flesh; frozen flavor and texture better than Babygolds.
562021	-2-1/2	2-3/8-1/2	YO	0	Comparable to Babygolds.
NJC 11	-2-1/2	2-1/2	Y	1-	Comparable to Babygolds.
NJC 78	-2	2-1/2	Y	0	Comparable to Babygolds; clear yellow skin.
Babygold 6	-2	2-1/2-3/4	Y	1-	Very good quality.
561994 A	-2	2-1/2	YO	0	The only clingstone judged better in flavor than Babygolds.
Ambergem	-2	2-1/2-3/4	Y	2	Only cling previously grown in N. E. America; not quite as good flavor as Babygolds; red pit problem.
NJC 22	-2	2-1/4-3/4	Y	1-	Similar to Babygolds.
Babygold 7	-1	2-1/2-3/4	Y	1-	Very good quality; small pit.
Dixon 1	-1/2	2-1/2	Y	0	In quality range of Babygolds 8 and 9.
Babygold 8	0	2-1/2	Y	1-	Good quality, similar to Babygold 5, 6, and 7.
Babygold 9	+1	2-1/2-3/4	Y	1-	Good quality, similar to Babygold 5, 6, and 7.
571963	+1	2-1/2-3/4	YO	1-	Very firm fresh fruit; comparable to Babygolds in processed quality.

1/ Y = yellow; O = orange.
2/ O = clear; 1 = slight; 2 = mush.
3/ Except where noted, processed quality remarks refer to canned quality.

new varieties. This is also important in evaluation of the selections that are available for parents for the development of the varieties of the future.

Several widely grown varieties were found to produce a satisfactory product, either heat processed or frozen (table 2). However, only a few of the new freestones were found to be equal to or better than the high quality variety Sunhigh, which was considered the standard for quality.

Table 2.--Horticultural and processing characteristics of certain freestone varieties and selections

Variety or selection	Weeks ripe from Elberta	Size (in.)	Flesh color 1/	Processing potential	Remarks
NJ 202	-5-1/2	2-1/2	Y	Canned	Freestone when fully ripe; good for very early ripening.
Redhaven	-4	2-1/2	Y	Canned and frozen	Present standard for early ripening freestones.
NJ 208	-3	2-3/8-1/2	Y	Frozen	Better quality than Sunhigh.
Sunhigh	-2-1/2	2-1/2-3/4	Y	Canned and frozen	Standard of fresh quality; standard of excellence for canned and frozen samples.
Redqueen	-2	2-1/2	Y	Canned and frozen	Hardy; very new variety; slightly better flavor than Sunhigh canned; better flavor than Sunhigh frozen.
Summercrest	-1	2-1/2-3/4	Y	Frozen and canned	Outside remains greenish until fully ripe, thus not attractive as fresh fruit; very good frozen quality.
Blake	-1/2	2-3/4-3	Y	Canned and frozen	Firm; excessively red at pit; poorer quality than Sunhigh; lye peeling difficult.
Redskin	0	2-1/2-3/4	Y	Frozen	Firm; green "coat" after lye peeling--not after freezing.
Elberta	0	2-1/2-3/4	Y	Canned and frozen	Dull; old standard; poorer than Sunhigh.
Jerseyqueen	0	2-3/4	Y	Canned and frozen	Firm; very good new variety.
Honey Dew Hale	+1/2	2-3/4	W	Frozen and canned	Firm enough to process well; unique flavor; makes attractive frozen product; browns quite rapidly.

1/ Y = yellow; W = white.

NJ 202 was found to produce a good quality product when heat processed, unusually good for such an early ripening peach. It could only be considered to be a freestone, however, when it was fully ripe. NJ 208 was found to be better quality frozen than Sunhigh.

These tests confirmed earlier experience that, while unattractive as a fresh fruit, Summercrest is very good frozen. A new variety, Redskin, was also found to be good for freezing. Two very recently named varieties from the New Jersey Peach Breeding Project, Redqueen and Jerseyqueen, seemed to be promising for both freezing and heat processing.

On the basis of the evaluation of Honey Dew Hale, a white-fleshed sport of J. H. Hale, it seems likely that a firm white-fleshed peach could make a very attractive and desirable processed product.

Nectarines

Of the numerous nectarine varieties and selections tested for processing potential, few demonstrated any promise based on our data (table 3). Two problems were common to most samples: (1) Difficulty in pitting owing to their soft-flesh texture and frequently the lack of a free pit, and (2) a tendency to take on an unattractive greenish-yellow color after heat processing.

The soft-texture problem was further complicated by the somewhat fibrous nature of the flesh of most samples such that, after peeling and spray washing as well as after

Table 3. --Horticultural and processing characteristics of certain nectarine varieties and selections

Variety or selection	Weeks ripe from Elberta	Size (in.)	Flesh color 1/	Processing potential	Remarks
551025	-5	2-1/2-3/4	Y	Canned	Rated comparable in quality to Sunhigh.
550893	-5	2-1/2-5/8	Y	Canned	Rated comparable in quality to Sunhigh.
Merrill Princess	-4-1/2	2-1/4-3/8	Y	Canned	Semifreestone; difficult to pit.
Nectared 7	-1	2-1/2-5/8	Y		
Nectared 8	0	2-3/8-1/2	Y	Frozen	Slightly better than Nectared 7.
Nectalate	+1-1/2	2-1/2-5/8	W	Frozen	Better flavor and texture than Nectared 7; very soft; difficult to peel.

1/ Y = yellow; W = white.

canning, these samples had a ragged appearance. This was reflected in the relatively high shear-press texture data of the canned products.

The latter problem has been noted by other workers with peaches grown with high nitrogen fertilization. It is believed that, in the case at hand, the fertilization was not principally responsible, but rather, that it was a varietal characteristic. Although they were considered much better than most of the nectarine varieties, the Merrill Princess, Nectared 7, Nectared 8, and Nectalate (table 3) were all subject to this problem to some extent.

The above-named varieties were all tested in 1962, using Nectared 7 as the reference sample. In 1963 and 1964 freestone peaches were used as the reference, because it was felt that for a processed nectarine to be acceptable, it must be of a quality comparable to a product known to be acceptable to the public.

The 1963 test samples, whether canned or frozen, generally did not compare favorably with the freestone standard of quality in flavor or texture, and again the greening was evident.

In 1964 a "breakthrough" was observed in the testing of selections 551025 and 550893. Although both selections were rated poorer in the flavor of the frozen product, both the flavor and texture of these samples when canned were rated comparable to the high quality freestone peach, Sunhigh. In addition, the color of these samples was fully acceptable, and no greening effect was observed.

This suggests that nectarine varieties can be developed which are suitable for heat processing and which can offer the public a new and pleasant canned dessert fruit.

Conclusions and Summary

A total of 61 clingstone peaches, 46 freestone peaches, and 25 nectarine varieties and/or selections have been evaluated for commercial canning and freezing potential. Of these, many of the new clingstone selections from the New Jersey breeding program were selected as having processing potential based on their chemical, physical, organoleptic, horticultural, and processing characteristics. Two nectarine selections, two freestone peach selections, and two newly named freestone peach varieties were identified as having processing qualities (canning and/or freezing) comparable to or better than the best varieties now being used for processing.

Frozen processing via vacuum packing in metal cans was found to produce a highly

desirable frozen product without added ascorbate for prevention of browning.

Ascorbic acid (vitamin C) content of numerous fresh and heat-processed samples were higher than literature values for this vitamin.

Provitamin A content of the test samples determined chromatographically as β-carotene, was significantly lower than the literature values for fresh peaches. The frozen and canned products did not have the high processing losses as reported in the literature. The implications of these findings have been discussed.

Correlation analyses indicated that the processed value of a number of objective factors of the canned and frozen fruit can be predicted from the fresh fruit analysis. These included pH, total acidity, ascorbic acid, and β-carotene. In the case of texture the fresh analysis was highly correlated only with the frozen product texture value--not with the canned texture value.

In some instances, the analysis conducted 5 days after canning was a good indicator of the analysis after 6 months' storage of the canned product. Included in this group was pH, total acidity, and soluble solids.

Fresh ascorbate content had a high correlation with processed β-carotene content, but most interactions between objective analysis were too variable for definitive evaluation.

Correlation between objective analyses and sensory evaluation data were also subject to excessive variation.

Thus, while certain objective quality factors of the processed fruit can be predicted on the basis of the analysis of the fresh fruit and/or on the basis of the analysis 5 days after canning, it has not been possible to predict total canned or frozen fruit quality on the basis of objective analysis(es) of the fresh fruit.

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DISCUSSION

Question: I'd like to ask Dr. Harris three questions about the pasteurized peach slices. What was the retail price of the 28-ounce size? What was the time in the pasteurizer, and what was the maximum price for that?

Dr. Harris: The time in the pasteurizer varied. I'd say around 4 minutes was adequate. We adjusted to reach a temperature of 160° F. in the center of the jar. Incidentally, I believe you will find this information in the mimeograph report.

Regarding the price on the product used in the market test, first let me say that the test was made with the 16-ounce jar. Dr. Miller experimented with different prices. He concluded that 35 cents, I believe, would be a good price for that particular pack. He did use different prices in his studies. Does that answer the question?

Question: What is the main purpose for refrigerating the product? Is it mainly to retard this matter of activity, since it seems to me with the chemicals you add, it would actually activate the bacteria. So it is mainly an addition of enzymatic activity that we are trying to achieve.

Mr. Heaton: It is for two reasons. First, the peach slices are protected from microbial spoilage by refrigeration to allow the preservative time to penetrate into the slices. The second is to retard ripening and other enzymatic activity.

Question: Dr. Harris, you mentioned 1 minute and 40 seconds, I believe, on this sterilization.

Dr. Harris: I made the statement that we had been able in experimental tests to obtain an essentially sterile product with as low as 1 minute and 40 seconds.

Question: At what temperature were you working?

Dr. Harris: One minute and 40 seconds in steam at 212°, with a jar rotating at 50 r. p. m. The required time would vary with the pack. One that is a little overripe would require more time than one in which there is considerable firmness in the slices. I wish to repeat that we don't recommend that

short a pasteurization period. We are thinking in terms of around 4 minutes in steam at 212° F., with the jar rotating at 50 r.p.m.

Question: Dr. Hoover, have you ever tried your freeze drying technique on dried syrup processed peaches?

Dr. Hoover: Yes, we have. We found that we have some problems with peaches. But the main thing is the freezing temperature where syrup is used.

Questioner: I am speaking of peaches that have been dipped in syrup, you know, then drained and put through your process.

Dr. Hoover: Yes, we have done that.

Question: What was the technique, Dr. Hoover, that you used in impregnating peaches? Dr. DiMarco mentioned it.

Dr. Hoover: Yes, I developed a continuous vacuum impregnator. I have been working with a commercial company in the operation of this unit. We have 1 year of experience in working with apples. I have done some in the lab with peaches. It is also a blancher, if anybody would be interested in that phase.

It is a continuous unit. It can eliminate a lot of labor and we think that it has quite a potential.

SIXTH SESSION

CONCENTRATES AND DEHYDRATED PRODUCTS

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PEACH PUREE AS A BASE FOR DRINKS

by
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(Presented by E. K. Heaton)

Peaches are grown in the Southeast primarily for the fresh market and secondarily for processing. In 1963, more than 4,288 cars of peaches were shipped from Georgia. Although 38 varieties were included, 10 accounted for 91.2 percent of the State's movement. It is significant that three of the midseason varieties--Coronet, Keystone, and Dixired--accounted for 48.9 percent of the shipments. Many of the peaches grown are of the melting flesh, clingseed, and semiclingseed varieties which are not suitable for freezing or canning except for pickles. Therefore, disposing of surplus peaches is a problem. Surplus peaches as used in this report include: (1) Over-ripe fruit from packing sheds; (2) prime fruit of one variety which has been superseded by a later ripening and more popular variety; (3) fruit damaged by hail or minor diseases; (4) undersized fruit; and (5) fruit not suitable to ship for other reasons.

Processing in Georgia has been largely restricted to canning, small volume freezing, and preserving of freeseed varieties, and pickling clingseed varieties, with some low quality fruit of both varieties used for wine stock.

It is estimated that in 1960, 250,000 bushels of peaches were unharvested in Georgia and 140,000 bushels were lost as culls. This means that 390,000 bushels, or 7.4 percent of the crop, were not utilized in any form. It is further estimated that at least 50 percent of the peach crop in the Southeast should be processed in some form.

Purpose

To attempt to find a feasible means of utilizing surplus southeastern peaches through processing.

Review of Literature

Pulpy fruit beverages were suggested by Cruess (4) as early as 1923; however, it was about 1935 before commercial production began on an important scale. Currently the most important pulpy beverage products are apricot nectar, peach nectar, tomato juice, and pineapple juice.

Beavens and Beattie (3), Atkerson (1), and Lee and Pederson (7) described procedures for making peach purees and nectar. The tree-ripened peaches were washed, halved, pitted, heated, and pureed in a juice extractor, or mill. The J. H. Hale, Elberta, South Haven, Champion, and Crawford varieties were studied. In these three studies the peaches were heated to 140°, 190°, and 160° F., respectively. Heating reduced color oxidation and aided in pureeing. Barber and Gerber (2) stated that steaming peaches to 150° F. internal temperature helped to prevent discoloration without developing a cooked flavor. Eisenhardt and coworkers (6) found the key to preservation of fresh flavor in peach concentrates to be rapid inactivation of naturally occurring enzymes early in the process and recovery of volatile flavor during concentration. Dimick and coworkers (5) studied the functions of time, pH, and temperature on the inactivation of polyphenolase in fruit puree and reported that 94 percent of this enzyme was inactivated at 158° F. in 15 seconds.

All the work reported was with Elberta or other well known varieties with practically no attention given to the melting flesh clingstone varieties which amount to a sizeable proportion of Georgia peach crop.

For making a puree drink base using many varieties of peaches, several questions needed to be answered. They included such factors as peeling and heating the fruit and concentrating and standardizing the puree.

Procedure

The peaches, cling, semicling, and freestone varieties, used in these studies were obtained from the Department of Horticulture at Experiment, Ga., the U. S. D. A. Horticulture Field Station, Fort Valley, Ga., and commercial orchards throughout the State. The fruit was selected on the following basis: (1) Season of ripening--early, medium, and late; (2) uniformity of ripening; (3) color of peel and flesh; (4) commercial availability; (5) grade; (6) resistance to bruising and discoloration; (7) chemical composition--amount of sugars, acids, and tannins; and (8) desirable aroma and flavor.

The peaches were prepared in several ways, but essentially by: (1) Grading for prime ripeness and freedom from objectionable defects; (2) washing; (3) peeling with hot lye solution (about 5 percent) either by immersion or continuous spray methods; (4) washing off excess lye and loosened peel; (5) inspection and removal of any undesirable fruit; (6) pitting by hand or machine; (7) treating with ascorbic acid and pureeing in juice extracting equipment with screens ranging from 5/16 in. to 0.026 in. holes; (8) pasteurizing and cooling through heat exchangers; and (9) packing cold and freezing or packing hot, sealing, and cooling.

Drinks made from the puree base were evaluated by sensory panels, a consumer acceptance panel on a national scale, in cafeterias, at luncheons and banquets, and in tin cans and glass jars in chain stores and other retail outlets.

Results

After 3 seasons of testing about 25 varieties and trying equally as many variations of procedures, results showed that several of these cling and semicling varieties were highly satisfactory for juice drink base when blended with late maturing freestone.

To study the effects of peeling peaches on the quality of puree drink base, five varieties--Hyland, Dixired, Redhaven, Keystone, and Cardinal--were used. With the first four varieties, evaluation of puree made from steam-peeled and unpeeled peaches showed: (1) Peeling improved the appearance, aroma, color, and flavor, but did not appreciably affect soluble solids, pH, titratable acidity, viscosity, cloud, or rate of sedimentation before concentrating. Table 1 illustrates a portion of these data. (2) Peeling reduced the yield by about 12-15 percent. (3) The peel added red color that changed to various shades of purple or brown during further processing. (4) It added "leafy" bitter flavor.

Table 1. --The influence of peeling peaches on the quality of puree drink base (Average of three varieties).

Quality factors	Peeled	Not peeled
Soluble solids	11.2	11.3
pH	3.69	3.72
Total acid (as citric)	.569	.526
Viscosity, c.p.s.	223.2	226.9
Turbidity, percent T. at 510 mμ	40.9	14.5
Sensory scores (0 to maximum of 20):		
Appearance	14.9	11.1
Aroma	15.3	10.9
Color	14.7	10.5
Texture	15.1	14.4
Flavor	13.8	10.9
Volatile reducing substance	17.3	14.9

Peaches of the Cardinal variety were used to compare purees of: (1) Washed, unpeeled peaches; (2) cold water washed, buffed-unpeeled; (3) hot/cold water washed, buffed-unpeeled; and (4) lye peeled. Results showed that 24 hours after preparation there was no detectable difference in the flavor of purees made from washed and buffed or peeled peaches. However, the puree made from peeled peaches had a slightly superior texture and consistence, and the color was significantly brighter.

After 6 months' storage the puree made from peeled peaches had superior appearance, aroma, color, and flavor to that made from unpeeled peaches that had been washed, washed and buffed, or hot/cold washed and buffed (table 2).

Peeling was highly desirable, as a more consistently uniform product was obtained throughout the season. Some varieties had a heavy concentration of red pigments in the peel which, if dissolved in the juice, turned various shades of purple or brown during storage or exposure to high temperatures. Peeling efficiently removed these and any foreign material as spray residue.

Effect of heating peaches on the quality of puree drink base. Results (table 3) showed that: (1) Adequate heating reduced the red component, stabilized the color and flavor, increased the soluble solids, acidity, and viscosity of some varieties, and slightly reduced sensory scores; (2) inadequate heating accentuated discoloration and development of abnormal aromas and flavors; and (3) additional heating produced a cooked (though not objectionable) aroma and flavor, reduced the red, and resulted in a product that was much more stable against oxidative deterioration. Heating to 180° F. or higher caused precipitation of compounds (probably including albuminoids) which decreased the cloud in the finished product. Results indicated that advantages gained by heating more than offset the changes in sensory scores.

The influence of concentrating on puree quality. The puree of peaches was thick, heavy, and viscous, due to the large amount of pectin and cellular material present. Concentration was slow and resulted in a very thick and sometimes jelled product. It also resulted in a product with less volatile aroma and flavor that could not be restored to its original palatability. These characteristics varied with varieties, degree of ripeness, and season of ripening.

Table 2. --The effect of peeling, washing, and buffing Cardinal peaches on puree drink base stored 6 months at 0°F.

Quality factors	Peeled	Cold wash	Cold wash buffed	Hot/cold wash and buffed
Soluble solids	10.9	11.3	12.1	12.0
pH	3.62	3.55	3.55	3.55
Total acid (as citric)	.496	.484	.503	.541
Sensory scores (0 to maximum of 20):				
Color	19.0	16.0	16.0	15.0
Aroma	18.0	12.0	15.0	13.0
Flavor	16.0	11.0	12.0	10.0

Table 3. --The influence of heating peach pulp to 180°F. on the quality of puree drink base (Average of three varieties).

Quality factors	Heated	Not Heated
Soluble solids	11.1	11.2
pH	3.68	3.70
Total acid (as citric)	.571	.564
Viscosity, c.p.s.	241.0	206.0
Turbidity, percent T. at 510 mμ	38.4	26.9
Sensory scores (0 to maximum score of 20):		
Appearance	13.1	16.8
Aroma	13.0	14.9
Color	13.1	16.8
Texture	14.7	11.7
Flavor	12.9	14.7

Results of concentrating puree from Dixired, Sullivan Elberta, and Elberta varieties twofold and threefold showed that the three varieties responded similarly in that volatile aromas and flavors were reduced, however, the reconstituted and standardized purees made high quality drinks. The three varieties responded differently in the following respects: In the Dixired variety, concentrating reduced the viscosity and acidity, imparted a slightly gray color, and prevented separation. Concentration improved the color slightly. For the Elberta variety concentrating reduced the sheen, increased the viscosity, and developed aroma and flavor of dried peaches.

The original quality of the concentrates of each of the three varieties was well retained for longer than 8 months at 0°F. Table 4 gives the average properties for concentrated puree from the three varieties.

Standardizing puree was necessary. Representative varieties grown in Georgia which were used for puree included Coronet, Dixired, Elberta, Fair Beauty, Keystone, Ranger, Loring, Southland, Redhaven, Redskin, Richhaven, and several horticultural selections. Because each variety had specific characteristics, it was necessary to blend certain varieties, particularly early season with late season varieties and then standardize the mixture as to color, viscosity, sweetness, and acidity. It was found that most of the varieties grown for the fresh market were suitable for puree drink base when blended in the proper proportions and standardized. Major problems were selecting varieties at prime ripeness with optimum volatile flavors/sugar/acid ratio; suitable for mechanical handling and processing; with a maximum of yellow color, minimum of red color, and minimum tendency to oxidative deterioration; and which ripened uniformly on all sides and withstood reasonable handling and hauling after becoming ripe.

A highly acceptable peach puree base for drinks was prepared from blends of varieties, and the use of additives to produce a product with soluble solids in the range of 24 to 28 percent; total acidity in the range of 0.75 to 0.80 percent; viscosity from 350 to 420 c.p.s.; and yellow color with slight pink.

For soluble solids adjustment 11.56 pounds of sugar was required to raise the soluble solids of 1,000 pounds of puree 1 percent. For acid adjustment 1 pound of citric or malic acid increased the acidity of 1,000 pounds of drink base by 0.01 percent total acidity.

The reconstituted puree base made a high quality drink as shown by results of sensory panels and consumer acceptance based on 13,000 servings at cafeterias, restaurants, luncheons, banquets, etc. The results of these tests showed peach juice drink to be preferred to other juices, including tomato, grapefruit, apple, grape, V-8, prune, apricot, and pineapple, listed in order of their preference. The results confirmed that the preference was for orange juice, with peach drink being second.

Evaluations were made of 21 peach purees and juices for possible blending with orange juice. Six showed possibilities of being blended with orange juice at the rate of about 15 percent. Keystone, Sullivan Elberta, and Elberta were suitable varieties. Encouraging results were also obtained by blending peach puree with pineapple juice, lemon juice, and ginger ale.

Peach puree may be suitable for ice cream. A comparison of the flavor score and stage of maturity with respective pH, acidity (citric) and soluble solids of puree of 14 varieties, used in ice cream, did not show any appreciable correlation. It is

Table 4. --The influence of concentrating on the quality of peach puree drink base (Average of three varieties)

Quality factors	Single strength	Double strength	Triple strength
After concentrating:			
Soluble solids	10.0	22.5	30.2
Total acid (as citric)	.546	1.179	1.711
Separation, percent	36.7	1	0
Aroma score (20)	12.7	10.7	11.0
Color score (20)	14.7	12.3	12.3
After reconstituting and standardizing:			
Soluble solids	17.5	17.5	17.6
Total acid (as citric)	.603	.650	.634
Sensory score (0 to 20 maximum):			
Appearance	15.0	15.2	13.2
Aroma	13.2	11.6	12.8
Color	15.8	15.2	13.6
Texture	12.4	12.8	12.2
Flavor	13.6	12.4	12.6

believed that only varieties of superior flavor should be used in ice cream instead of standardized blends of varieties, which must be fortified with artificial flavoring.

Pilot-plant studies. During the 1964 season, a total of 52,909 pounds of puree were prepared from 2,623 boxes, or approximately 105,120 pounds of peaches. This included 1,329 boxes (53,160 pounds) of clings which yielded 27,078 pounds of puree for a processing yield of 50.9 percent, and 1,294 boxes (51,760 pounds) of freestones which yielded 25,831 pounds of puree for a processing yield of 49.9 percent.

In a pilot-plant test, puree was prepared from more than 2 dozen varieties and selections, including those that ripen early, midseason and late; also included were clingstone, semicling, and freestone varieties. The fruit was of high, medium, and poor flavor, 28,941 pounds from B-grade peaches, and 23,968 pounds from assorted, tree-ripe orchard-run peaches.

Some characteristics of the puree were:

	Clingstone	Freestone
Soluble solids	10.7	10.2
pH	3.76	3.79
Total acid (as citric %)	.663	.637
Viscosity, c.p.s.	319	253

The puree was frozen in fruit enameled 30-pound tin cans and plain 25-pound cans lined with polyethylene bags and stored for about 3 months. It was transferred to Winter Haven, Fla., by refrigerated truck, stored at -20°F. for 1 month, then blended, adjusted, and repacked into 12-ounce cans.

The 34 different purees were combined into 5 lots on the basis of variety, time of ripening, and characteristics of the puree. In order to obtain a blend of approximately uniform color, viscosity, soluble solids, and acidity, a calculated portion of the puree from each of the five lots was mixed into each batch. There was a total of 14 batches of 500 gallons each, or 7,000 gallons. The standardized puree was pasteurized at 196°F., hot-filled into 12-ounce (211 X 414) cans, immediately cooled, labeled, and cased.

Results of this test showed that the procedure followed in preparing the puree and storing at 0°F. until it was later adjusted and repackaged appeared satisfactory. The size of container (30-pound cans) was too small and unsatisfactory, with 50-gallon drums being preferred. By blending the puree it was found possible to use more varieties of peaches which ripened early, medium, and late, as well as varieties which

produced puree having a wide range of colors.

The peach drink was tested at Emory University cafeteria which serves around 10,000 meals each day. The peach drink was offered at competitive prices alongwith 9 other juices at each meal. The results confirmed that the preference was for orange juice--37.8 percent of juices--with peach drink being second at 17.4 percent. Other juices in order of preference were: Tomato, 12.4 percent; grapefruit, 11.8 percent; apple, 8.3 percent; grape, 3.3 percent; V-8, 2.7 percent; prune, 2.6 percent; apricot, 2.2 percent; and pineapple, 1.7 percent.

A nationwide survey was made in cooperation with the Home Makers Guild of America which is made up of volunteer consultants representing a cross section of American home life.

Among the 2,000 consultants participating in this study, the average age was 43 years, the average number of children per family was 2.04. The distribution of consultants was 25 percent in the East, 30.8 percent in the South, 29.0 percent in the Midwest, and 15.2 percent in the Far West.

A single quart bottle of peach drink prepared from concentrate was mailed to each consultant, along with a questionnaire.

Regarding consultants' opinion of "taste" and "consistency," 77 percent and 75.8 percent, respectively, stated that these qualities were "just right;" 14.3 percent thought the drink was too sweet, and 23.5 percent thought it was too thick.

Most (78.5 percent) stated they would buy peach drink if it were available at a reasonable price; 75.8 percent preferred a ready-to-drink beverage to one requiring reconstituting; and 56.8 percent stated that vitamin content influenced their purchase of fruit drinks.

On the basis of these results, a new plant (Val-Mar, Inc.) Marshallville was designed and built to prepare puree base for drinks. Production was slightly over 3,000, 55-gallon barrels of peach drink base from about a dozen commercial peach varieties. They ranged from early clingstone to late freestone varieties with wide differences in flavor and color. The peaches came from an area within 100 miles of Marshallville.

Steps in the Preparation of Peach Puree Base

After three seasons of testing many varieties and variations, the following procedures were developed:

1. Receive fruit within 12 hours after picking.

2. Cool fruit to be held overnight, and ripen that which is not yet soft.

3. Grade for ripeness and freedom from defects. Select worm-free, rot-free, soft fruit of any variety.

4. Peel by immersing in, or spraying with, 5 percent lye at 210°F. for 30 seconds, then expose to air for 1 to 2 minutes.

5. Wash with rotary or spray washer.

6. Wash lightly in soft-brush washer, remove rotten spots by trimming, and rewash.

7. Heat whole fruit in continuous thermoscrew for 2 minutes at 200°F., to aid in pulping, prevent oxidation, and stabilize cloud in puree. A jacket around the screw should maintain 20 pounds steam pressure.

8. Pulp by passing through continuous rotary unit with 1/4-in. perforated screens to remove soft flesh from seed and unripe portions.

9. Finish the pulp by passing through rotary unit with 0.033 in. or 0.024 in. perforated, stainless steel screen. This reduces pulp to liquid and removes fiber.

10. Accumulate in tank, add 0.14 percent ascorbic acid and mix, then feed uniformly to pasteurizer.

11. Pasteurize at 190° to 200°F. and cool quickly to 35°F.

12. Fill asceptically into sterile 55-gallon drums or large cans for refrigerated storage. Filling hot in No. 10 or smaller size cans may also be used.

13. Close cans using vacuum and nitrogen, or vacuumize with steam jet.

14. Cool cans (which were not already cool) in canal or water spray.

15. Dry cans with warm air, to remove water drops, and avoid rusting or staining of labels.

16. Label containers, use code identification.

17. Store in cool dry place.

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CONCENTRATED CLEAR PEACH JUICE

by
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Basic investigation into the production of clear juice peach concentrate was started by Monarch Wine Company in 1960. The major problem involved had always been the economical separation of the peach juice from the pulp.

In the production of wine, this separation was accomplished by filtration after fermentation. This process required tremendous amounts of diatamaceous earth; filter cycles were also short, resulting in excessive cleandown time and manpower losses. In addition, quality control problems were magnified; proper dispersion of control chemicals was very difficult in the heavy pulp; and control of spoilage on the top of the pulp was very hard. In many cases these conditions prevented the proper control of wild yeasts and resulted in a wine of inferior quality.

During 1960, a test was made on a Willmes Pneumatic Press and resulted in the separation of a juice of fairly good quality. Although some fine particles of pulp remained, about 90 percent of the pulp was removed. Based on these test results, Monarch purchased a large press for the 1961 season.

At the beginning of the 1961 season, Monarch delivered 5 barrels of peach juice to the Experiment Station at Griffin and requested assistance in the development of a clear juice peach concentrate.

EARLY DEVELOPMENT

The first concentrate produced was on the small Low-Temp evaporator at the Experiment Station. Results were very disappointing. Browning was so intense that the concentrate came out almost black in color. It was obvious that a Hi-Temp operation would be required to produce a good product. Shortly thereafter, the Experiment Station obtained a pressure kettle which was converted into a vacuum kettle. As a result, we were able to produce experimentally a concentrate of fair color and quality. This was sufficient evidence to Monarch that a peach juice concentrate of good quality could be produced.

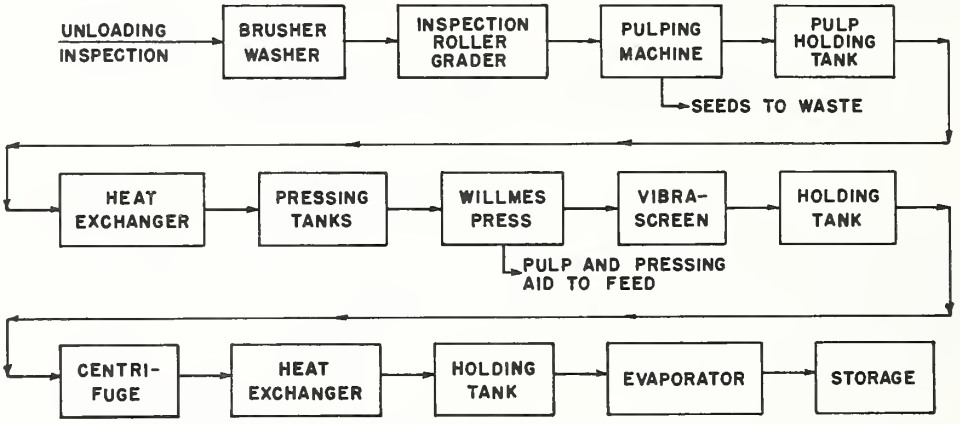
An attempt was made to establish a concentrate facility in 1962; however, plans were not complete before the peach season and these plans were abandoned.

In the spring of 1963, a small group of growers and Monarch Wine combined to establish a small concentrate facility at Monarch's premises. This plant was primarily for the production of concentrate for wine making and to make tests as to acceptability of peach juice concentrate by the food industry. Peach wine sales had also increased to such an extent that we were unable to store sufficient fruit to meet the demand without reducing the juice to concentrate form.

OPERATION

The basic operation is shown by the flow diagram in figure 1. Peaches are first dumped from the truck on a conveyor belt for initial inspection and are conveyed to a brusher-washer. Peaches having pinrot or brown spots are removed at this inspection. The fruit then travels from the washer to a roller-grader, at which point a second inspection takes place to remove any remaining substandard fruit. From the roller-grader the fruit is fed into a pulping machine where the fruit is removed from the seeds. The seeds are conveyed to a dump truck for removal, and the pulp flows into a holding tank. The pulp is then pumped through a stainless steel heat exchanger heated to 160° F.; cooled to 100° F. into pressing tanks. In the pressing tank, a pressing aid is added along with a pectinol enzyme. The pressing aid found to be most effective has been rice hulls. After mixing for about 30 minutes, the material is transferred to a Willmes press and juice removed. Pressing residues are conveyed from the press to trucks and used for cattle feed. The juice is sent through a vibrascreen to remove any rice hulls that may have come through the press and to a holding tank. From this point the juice is further treated by centrifuging to remove the last particles of pulp. The material removed here is more of a peach paste. The juice is then heat exchanged to another holding tank and then sent to the evaporating unit. From the evaporator, concentrate is stored in 50-gallon drums under refrigeration.

In July of 1963 duplicate samples of concentrate were canned by using various methods of preservation. One can was placed under refrigeration of less than 40° F., and the other stored at room temperature. In all cases browning occurred at room temperature where very slight or no browning occurred when stored under refrigeration. Percent light transmission was reduced from 68 to 72 under refrigeration to 13 to 20 percent at room temperature. Although oxidation and enzymatic browning may have occurred to some extent, it has been our conclusion that most of the browning was due to the Maillard reaction on samples which were not under refrigeration. Some of the results of these tests are shown in table 1.



PEACH JUICE CONCENTRATION LINE

Figure 1

Table 1. --Effect of storage temperature on peach concentrate

Preservative	Stored in cold room		°Brix	Stored at room temperature	
	Percent light transmission	Taste		Percent light transmission	Taste
No preservative	68	Good	64	18	No peach flavor
Sorbistat K 4 lbs./1,000 gal.	68	Good	64	18	No peach flavor
Sodium benzoate 0.1 percent	69	Good	64	18	No peach flavor
Pasteurized	51	Fair	64	13	No peach flavor
Ascorbic acid and pasteurized	62	Good	64	18	No peach flavor
100 mg. ascorbic acid 0.1 percent sodium benzoate	70	Good	64	19	No peach flavor

An attempt was made the first year to maintain a nitrogen blanket during processing, however; due to the pressing and centrifuging it became a practical impossibility to maintain such a blanket.

USES

Because of increased wine sales, production from peach juice and concentrate has resulted in an increase in the use of peach pulp from 1 million pounds in 1960 to 6.5 million pounds in 1965. Approximately 60,000 gallons of peach concentrate 60° Brix was produced in 1965 to be used for wine production. Current peach wine sales will use most of this material before next peach season. It had been planned that we would be able to store sufficient concentrate to protect against a freeze; however, our sales have increased to such an extent that this is now impossible. Our present evaporator is now at almost maximum production.

Concentrated juice has been sold to other wineries--for use in fruit punch by a Florida drink producer and for the production of peach flavors to be used WONF. Some problem has been encountered in sales due to the absence of essence to be used in the restored concentrate.

Samples of this material have been furnished to producers of jellies, syrups, cereals, baby foods, and others. The problems in most cases appear to be loss of flavor during evaporation. In our opinion this matter can be overcome by essence recovery.

Owing to the relative newness of the product and the fact that literature on peach concentrate was practically nonexistent, it was necessary to expand our laboratory facilities to study materials produced and develop byproducts. Excellent results were obtained in the production of peach pancake syrup or topping and peach jelly. Ice cream was produced in cooperation with Dari-Tech in Atlanta with good results. Ice milk was produced by the use of a puree similar to that developed by the Experiment Station. These products have been presented to the dairy industry for consideration.

FUTURE OUTLOOK

There has been some investigation into the establishment of a concentrate plant for the production of a concentrate with essence recovery. It has, however, been our opinion that a peach concentrate plant alone would not be economically feasible. There should be sufficient raw material in the area to produce grape and apple concentrates in order to keep the plant running for 4 to 6 months.

The cost of building such a plant would run from $300,000.00 to $500,000.00 depending upon volume, due to the necessity for refrigerated storage of the product.

SUMMARY

It is our opinion that the development of this type of raw material for use in fruit drinks, syrups, and jellies is the only practical solution to the surplus peach problem. This process utilizes fruit that is undersized and misshapen and that cannot be used for the fresh market.

PARTIALLY DEHYDRATED PASTEURIZED PEACHES

by
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(Presented by J. G. Woodroof)

While dehydration is one of the oldest methods of preserving fruits, it has its shortcomings in industry and in the modern supermarket. Some of these, as applied to southeastern grown peaches, are: (1) The product lacks "convenience" in that an hour or more is required to reconstitute it for cooking, and even longer for serving; (2) the product is not "fresh" as compared to frozen or refrigerated fresh peach slices; (3) the product cannot be "reconstituted" fully in the sense that the original weight, color, texture, or flavor are not restored on soaking; (4) the process is slow and expensive under weather conditions prevailing in the Southeast, where the entire operation would have to be under controlled, artificial conditions; (5) the same fruit of the desired variety, grade, and ripeness can be more cheaply, quickly, and easily processed in another way; and (6) the last 15 percent, 10 percent, or 5 percent moisture removed is progressively more difficult, as compared with partial removal of moisture.

However, there are many reasons why southeastern grown peaches may be successfully partially dehydrated, sweetened, packaged, and pasteurized. The product is "convenient" for use directly in fruitcakes, pies, cereals, candies, and other products, since it has been peeled, practically cooked, and is edible as such. The product is practically "fresh" since only about half of the moisture is removed and can be rapidly restored if desired. The weight has been reduced to about one-fourth. While refrigeration is beneficial, it is not necessary. Since high temperatures are not used in processing, loss of volatile flavors and caramelization are reduced to a minimum.

Results in this report included the effects of peeling, sun drying, mechanical drying, combination of sun and mechanical drying, calcium salts for firming, and four preprocessing treatments. The preprocessing treatments were hydrocooling, air cooling, heating followed by hydrocooling, and storing. The quanity factors measured were firmness, acidity, soluble solids, moisture, processed yield, and sensory values of fried peach pies.

Description of peaches used. Because peach varieties grown in Georgia were not developed for dehydration products, we used promising fresh and canning varieties. Fruits of available varieties were obtained from the Georgia Experiment Station orchards at Experiment, USDA Horticultural Field Laboratory orchards at Fort Valley, and from commercial growers in the Fort Valley area.

Of 18 varieties used, the Blake, Dixigem, Elberta, Loring, Ozark, Redglobe, Redskin, Richhaven, Southland, and Sulliven Elberta were described by Savage and coworkers (1963). Descriptions of the Jefferson and Dixiland are reported by Brooks and Olmo (1960, 1962); those of FV 7-158, FV7-873, FV 7-1670, FV 325-59, and FV 575-96 are given by Prince (1964). These varieties may be grouped into three categories: Widely-planted, limited-planted, and test selections. Seven of the 13 named varieties are listed among the top 20 varieties grown in Georgia (Ford and Elrod, 1961). The experimental fruits were selected for uniformity in size, color, and maturity as they were picked from the trees. Limited supply of fruit of certain varieties extended the selection tolerances in some instances.

Preparation of fruit. The fruit was processed within 12 to 36 hours after harvesting, usually in lots of 4 to 100 pounds, as available. Fruit to be dehydrated with the peel on, were defuzzed in a Calgon and sodium tetraphosphate wash. Lots having the peel removed were immersed in a 5-percent lye solution at 200°F. for 30 to 45 seconds, allowed to drain for 1/2 to 1 minute, washed, graded, and dipped in a citric acid bath to prevent immediate oxidative browning. Some lots were hand peeled. The early ripening, semicling varieties were halved and pitted by hand; freestone fruit were halved and pitted by an Altman machine. Some lots were halved and pitted before lye peeling;

lots to be blanched were subjected to steam for 2 minutes. Fruit of some lots were processed whole without pitting. Conventional equipment on a pilot-plant scale was used for lye peeling, washing, grading, and blanching.

Peaches firmed with calcium chloride or citrate before removing moisture lost slightly more moisture, retained their original shape better with less shriveling and wrinkling, and had a more tender and crisp texture. Preprocessing treatments influenced the rate of drying. For example, from the most to the least rapid drying, the treatments were untreated, hydrocooled, heat/hydrocooled, and air cooled. Rate of drying increased after storage at 70° F. for 24 hours and 34° F. for 48 and 72 hours following preprocessing treatments. Peaches were more difficult to sulfur immediately after hydrocooling than before cooling or after storage.

Vacuumizing. A Lee vacuum kettle, 10-gallon, special model, was charged with a 30 percent sugar solution, half sucrose and half dextrose, containing 0.1 percent ascorbic acid. To this solution, antioxidant and antimycotic agents were added separately or in combination. The peach halves were submerged in the solution maintained at 120° F. A vacuum of 27 inches was applied for 2 minutes, released to atmospheric pressure, then repeated. After the tissue gases were removed by the vacuum and the solution allowed to penetrate the tissue during an interval of 5 to 10 minutes, the peach halves were drained.

Antioxidants and antimycotics. Sodium metabisulfite was used as the source of sulfur dioxide or the sulfite ion. Concentrations of 0.5 or 1.5 percent sodium metabisulfite were added to the sugar solution, corresponding to 3,300 and 10,100 parts per million of sulfur dioxide. Potassium sorbate was added to the sugar solution in a concentration of 0.1 percent, equivalent to 740 p.p.m. of sorbic acid.

Removing moisture. The fruit was placed on racks and loaded in a stainless steel "Oven-King," forced-air dryer, having a rack shelf space of 80 square feet. The rate of air change was 160 cubic feet per minute. With a temperature control of ±2°F. at a normal load, the relative humidity varied from 39 to 45 percent at 120° , and from 60 to 65 percent at 90 to 100° F. temperature. The peach halves were dehydrated at 120° F. and removed when the residual moisture was reduced to a point when the surface was neither slick nor tacky, and the product had a pliant "moisture-feel" texture. To avoid too-rapid or overdrying, the temperature control was set at 100° when judged necessary.

During the 1965 peach season, additional packs of partially dehydrated peaches were prepared. An experiment using microwave heating for dehydration was attempted. The source of microwave was a Westinghouse electronic range. The range was designed to cook with only high and low heat settings without intermediate controls. However, even at the low heat setting, a peach would boil after 2 minutes and be scorched after 5 minutes. This difficulty was somewhat lessened with a larger amount of peach load and frequent interruption of heating by turning off the heat.

Toward the end of the peach season, a new modification of preparing the fruit for dehydration was initiated. This consisted of dehydrating the peeled but not pitted peaches to the desirable final moisture content. The pits were then removed by hand. In so doing, the peeled peaches could be impregnated with syrup without having waited to be pitted. Also, less area of the peach was exposed to oxidation during dehydration, and some flavor may be enhanced while drying with the pits in. An unusual shape of final product was also obtained.

A brief description of the experimental packs of partially dehydrated peaches, prepared in 1965, is given in table 1.

Pasteurization studies on the partially dehydrated peaches. The partially dehydrated peaches after equilibrium of moisture were packed in sealed Saran-coated nylon bags. Pasteurization was carried out by immersing the bags with contents in a water bath for 30 minutes at 155° and 175° F. In addition, pasteurization was also done by heating with microwave to about 180°. These peaches, with the unpasteurized controls, were stored at 32° and 70° for evaluation. Full evaluation of the above packed peaches was not obtainable at the time of writing due to insufficient time lapse. However, after storage for 2 months at the above temperatures, all the peaches remained in very

Table 1. --Partially dehydrated peaches prepared in 1965

Variety	Syrup used Percent	Peach shape while drying	Drying	Final Moisture Percent
Sullivan Elberta	30	Peeled whole	120	41.1
Sullivan Elberta	30	Peeled whole	120	36.6
Sullivan Elberta	30	Peeled whole	120	31.0
Sullivan Elberta	30	Pitted halves	120	18.2
Sullivan Elberta	30	Peeled whole	Microwave	40.4
Sullivan Elberta	40	Peeled whole	120	35.6
Sullivan Elberta	50	Peeled whole	120	31.7
Redglobe	30	Pitted halves	120	38.0
Halehaven	30	Pitted halves	120	32.9
Southland	30	Pitted halves	120	28.8

good conditions both in color and flavor. There were not much differences in the color in the peaches pasteurized at 155°, 175°, and by microwave as compared with those unpasteurized. However, there appeared a slightly better color when these peaches were stored at 32° than at 70°.

Steps in preparation of dehydro-pasteurized peaches:

1. Receiving and cooling.

2. Ripening (when necessary).

3. Grading for size, ripeness, and defects.

4. Peeling by immersing in hot 5 percent lye.

5. Washing with rotary washer.

6. Brushing and washing.

7. Dipping in 0.5 percent citric acid to neutralize lye residue and prevent browning.

8. Halving and deseeding by machine or hand, or bypassing and pitting after dehydrating.

9. Vacuumizing, 27 inches for 2 minutes, release vacuum, and repeat. Hold fruit in solution of 30 percent sugar (1/2 sucrose + 1/2 dextrose), 0.1 percent ascorbic acid, 1.5 percent metabisulfite, and 0.1 percent potassium sorbate at 120°F.

10. Draining excess liquid and centrifuging at low speed.

11. Dehydrating to about 35 percent moisture at 120°F.

12. Pitting after dehydration only in some grades.

13. Equilibrating at 32° to 50°F. to uniform moisture content.

14. Packaging in Saran or other heat-sealable moisture-proof bags.

15. Pasteurizing 30 minutes at 155°F.

16. Storing in cool, dry place.

Equilibrating and pasteurizing. The fruit was packed in "Rilsan" nylon bags and stored at 32°F. to equilibrate, permitting migrating moisture with contained solutes--sugars, sulfur dioxide, potassium sorbate, and pigment--to come to equilibrium throughout the peach flesh. After 60 days' equilibrating storage, samples were taken for analysis. Moisture was determined by method of AOAC (1960); sulfur dioxide by the iodine-distillation method of Cox and Pearson (1962); potassium sorbate by the colorimeteric assay method of Nury and Bolin (1962). Evaluation was made for appearance, color, aroma, flavor, and texture. Lots were repacked in 4 in. x 6 in. nylon bags, containing not more than 8 ounces per bag, sealed, pasteurized in a water bath at 155°F. for 30 minutes, cooled, and stored at 70° and 55 percent relative humidity. Control lots were not pasteurized. After 60 days' storage at 70°, the products were evaluated by a 3-man panel for appearance and color. They were returned to storage at 70° for final evaluation

for appearance, color, aroma, flavor, and texture.

Reconditioning. The equilibrated peaches were ready to use in many products without reconditioning in any way. They were tender, sweet, and of good color and appearance. They would be used directly in fruitcakes, pies, tarts, and any other products as removed from the container.

For use in cereals or other raw products, a brief cooking was required. After being placed in an equal quantity of water, the fruit picked up moisture during heating and regained a great deal of the texture, color, and flavor of the stewed fresh peaches.

Sullivan Elberta peaches that were hydrocooled had a 10 percent lower rating and 8 percent higher moisture content, in the dried product, than those not hydrocooled. The moisture pickup during rehydration was 45 percent for the hydrocooled fruit and 58 percent for that not hydrocooled; corresponding figures for total solids were 13 and 15.7 percents. Figures for percent moisture pickup, percent soluble solids and p.p.m. sulfur dioxide for cook, dried hydrocooled peaches were 45, 18.6, and 358 while those for fruit not hydrocooled were 21.5, 22.2, and 1651, respectively.

Summary.

1. A dehydro peach product (30 to 50 percent moisture content) was prepared by: lye-peeling; pitting; vacuumizing while submerged in a 30 percent sucrose solution, containing 1.5 percent sodium metabisulfite and 0.5 percent potassium sorbate, at a temperature of 120°F.; dehydrating in a forced-air oven at 120°; and equilibrating and storing at 32°. The degree of quality can be judged by appearance, color, aroma, flavor, and texture of the finished product.

2. Regardless of the aroma, flavor, and texture of the product, the over-riding criteria of acceptability are color and appearance. Starting with a suitable variety (such as those suitable for canning) a good quality dehydro peach product will retain its color and appearance if stored at 32° F. Storage at 70° favors nonenzymatic browning which in time changes the original bright, yellow-orange color to progressively darker shades of dull brown, destroying acceptability of the product.

3. Since the rate of nonenzymatic browning, including the Maillard reaction, increases with higher temperature and pH, the rate and extent of browning were affected by many variable factors in a complex array of moisture, glucose, fructose, amino acids, ascorbic acid, the sulfite ion, antioxidants, and antimycotics. The interactions of these factors were evident in the variable experimental results of the present study.

4. Blanching was of doubtful value.

5. Pasteurizing was of doubtful value and may be deleterious due to the temperature required. However, initial enzymic browning must be controlled by using such agents as citric acid dip and the action of sulfite ions.

6. Peeling the fruit yielded a superior quality product to that of nonpeeled fruit. No differences were detectable between lye-peeled and hand-peeled fruit.

7. The mid- and late-ripening, freestone varieties yielded a better product than the early-ripening cling and semicling varieties.

8. Varietal differences are very important controlling factors affecting quality of the finished product.

9. The degree of maturity within the varieties affects the quality of the product. Fruits with a green side or over-ripe side are undesirable and should be culled.

10. The variable results of this study apparently point a way to a possible solution to the problem of processing an acceptable dehydro peach product capable of a shelf life of 6 or more months at 70°F. temperature.

11. Overall observation indicates that lye-peeled freestone peaches vacuumized while immersed in a solution of sugar and ascorbic acid, plus 1.5 percent sodium metabisulfite and 0.1 percent potassium sorbate, yielded an acceptable product superior in one or more characteristics, to that subjected to other variations of preparation and treatments.

Literature

Woodroof and coworkers (20) stated that commercial dehydration of peaches in middle

Georgia may be an opportunity in normal times; and that varieties suitable for dehydration are usually highly flavored, highly colored, quite acid, quite sweet, and firm; that they should be carefully picked without bruising and held in shallow containers 1 day until they develop a uniform color and texture.

Cruess and others (5) impregnated peach halves by immersing them overnight, and up to 24 hours, in a 40° Brix, mixed cane and corn syrup, drained, sulfured, and dehydrated to 22.7 percent moisture.

Woodroof and Cecil (20) reported that sulfur dioxide solutions in concentrations of 1,500 to 2,000 p. p. m. are an effective preservative for fruits to be processed later into other products.

Guadagni (7) in a freezing pretreatment, impregnated apple slices by immersing in a 40 to 60 percent syrup containing ascorbic acid, citric acid, and sodium bisulfite and applying a vacuum to remove tissue gases, which are replaced by the solution on release of the vacuum. He observed that water-filled slices were usually transparent, whereas syrup-filled slices were generally opaque. Guadagni and Nimmo (8) reported that vacuum applied to frozen peach packs further improved color and flavor retention.

Kitson and Atkinson (12) developed a vacuum process for sulfuring apricots, where the fruit was subjected to a 27 to 28 inch vacuum for 10 minutes. The vacuum was broken with sulfur dioxide gas, thereby reducing the time of sulfuring.

Joslyn and Braverman (9) in an extensive review of sulfur dioxide treatment of fruits quote Long and coworkers (14) who recommends as a guide that for final moisture content and storage conditions a concentration of 2,000 p. p. m. is adequate for peaches, while allowing for losses of SO_2 during processing, drying, and storage.

The age-old use of sulfur dioxide and subsequent sulfites apparently continues to be a problem. Schwarz (17) stated that there is a sizeable body of empirical knowledge fitted into a well defined technology that offsets the lack of an exact science. Stadtman (19) stated that by far the most important factor influencing the rate of browning in fruit products is temperature; yet very little reliable quantitative data have been obtained relating browning to temperature.

Burton and coworkers (1, 2, 3) investigated the influence of pH on sulphur dioxide, aldose-amino, and ketose-amino reactions as a browning retardant. Burton and McWeeny (4) described the routes to the production of mealnoidins from aldose and amino compounds.

Recent investigations by Jurd (11) elaborated on the reactions involving sulfite bleaching of anthocyanins. These investigations provide much aid in understanding numerous observations of apparent migration and diffusion of the red color in peaches, as well as the moisture, and contained solutes during the equilibrating storage periods of dehydro peaches.

Pratt and others (1954) confirmed the findings of others that ascorbic acid and anthocyanin pigments react which cause destruction of the pigment. They indicated that riboflavin may contribute to the unstability of anthocyanin pigments.

Joslyn and Ponting (10) described the use of citric and ascorbic acids and the effect of pH to prevent oxidative browning of peeled and cut fruit during processing.

McBean and others (15) reported that irrigated peaches absorbed sulfur dioxide at a much slower rate than nonirrigated peaches (by inference, peaches subjected to copious rainfall after a dry period would respond in a like manner); that uptake of sulfur dioxide by peach flesh was less through the skin than through cut or peeled surface; that spraying with water and blanching reduces sulfur dioxide absorption by the peach tissue. Lazar and coworkers (13) reported that blanching fruit in its undried state usually collapses the tissues and produces an inferior product, but partial drying before blending allows better control of texture and appearance.

To prevent mold growth, commercial packs of high moisture prunes are treated with sorbic acid or potassium sorbate. Deuel and others (6) reported that sorbic acid as a dietary component was harmless, being less toxic than benzoic acid. Smith and Rollin (18) reported that 0.05 percent sorbic

acid mixed into processed American cheese is sufficient to inhibit mold growth; that taste showed that there is no objectionable taste, odor, or color imparted to the cheese.

Nury and coworkers (16) reported that potassium sorbate is equal to propylene oxide and superior to other agents in preserving high-moisture prunes, and that it has a residual effect in that the treated prunes did not spoil in open packages.

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PROCESS FOR PREPARATION OF PEACH FLAKES

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and
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(Presented by J. J. Spadaro)

There is no question that the peach industry is probing, and perhaps I should say groping, for new peach products. And, as was pointed out yesterday, this is understandable because:

1. The housewife wants convenience foods

2. The number of peach trees decreased from 16 million in 1928 to 2.6 million in 1965.

As you have heard, and as most of you know, work has been done, and is being done on the development of products, such as peach concentrate, peach drink, and peach wine.

Peach flakes is another product that has commercial possibilities. It reconstitutes readily and retains many of the qualities of the peach puree from which the flakes are prepared. These flakes have potential use as a base for ice cream, cakes, dry mixes, drinks, and so forth. This peach flake development, which I am about to describe, is the result of cooperative work between the Southern Regional Research Laboratory and the Georgia Experiment Station. Puree prepared either at the Georgia Experiment Station or at one of the commercial companies and shipped frozen to New Orleans was used in these studies.

The use of surplus peaches. The process utilizes the soft ripe peaches of both freestone and clingstone varieties which cannot be used for canning or for the fresh market. Approximately 25 percent of the southern peach crop falls into this category. These fruits are usually very high in flavor, have very good color, and can be processed into high-quality peach puree for use in a peach drink and, as we will see in a few minutes, for use in preparation of instant peach flakes.

In describing this development, I will present first, the steps in the flake process and also the possibility of combining the production of peach flakes and peach drink. Second, the description of the pertinent steps in the process in the effect of certain processing variables including the use of additives.

Third, a few words about the flake product.

Processing Steps

The initial processing steps are similar to those used in the peach drink process. These are shown in figure 1. The steps are as follows:

1. Election and grading of the soft ripe peaches.

2. Peeling by immersing in and spraying with hot lye solution and then passing through an oxidizer chamber.

3. Washing with very fine sprays and brushing lightly with soft nylon brushes to remove the peel.

4. Inspecting and trimming to remove the bruised or rotten spots.

5. Heat in a continuous thermoscrew cooker equipped with a prebreaker.

6. Pulp with a Langsenkamp Model A pulper using 1/4 in. perforated screen and rod blades to remove soft white flecks from seed in unripe portions.

7. Addition of ascorbic acid to prevent oxidation and citric acid or EDTA as a chelating agent.

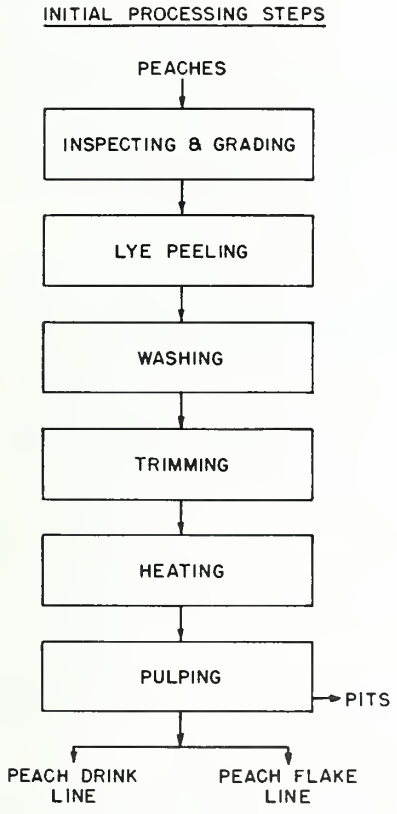

Figure 1

It is at this point that the flake process deviates from that of preparing a peach drink. In a combined drink and flake plant the feed line can be split with a portion going into each process.

The new additional processing steps required for flake preparation are shown in figure 2.

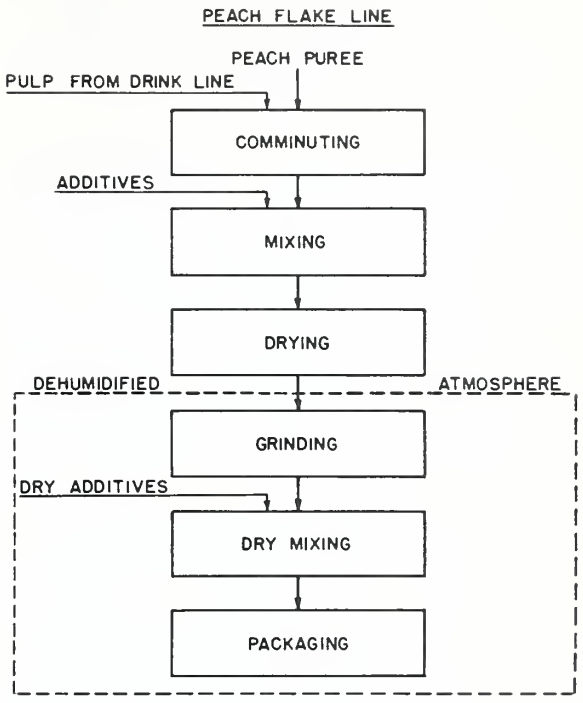

Figure 2

1. Communition through a hammer mill using a screen with 0.020 in. holes.

2. Incorporation of additives for the color preservation in flavor enhancement.

3. Addition of drying aid to the puree to facilitate the mechanical handling of the peach solids on the dryer.

4. Dehydration of the peach puree on a double-drum dryer with chromium plated drums.

5. Blanketing the dry peach solids with dehumidified air as they are discharged from the dryer and also while transporting them to the packaging area.

6. Grinding into flakes (still in a low-humidity atmosphere).

7. Packaging into any suitable sealed container.

As shown in the process flow diagram, it is possible in a combination drink flake plant to utilize some of the peach pulp normally discarded from the drink line by adding it to the puree going to the flake line. This does not degrade the quality of the peach flake and, as will be discussed later, it actually facilitates the drying operation.

Communition of pulp. A Fitzpatrick communition mill with a perforated screen was used to reduce the size of the pulp ingredients so that it could be more readily blended with the puree and not affect the quality of the reconstituted product.

Additives. The additives required can be separated into two groups. First, those used for flavor and color enhancement and those used to improve the drying characteristics.

Citric acid, ascorbic acid, or EDTA may be added to the puree to prevent color changes. Sucrose, corn syrup, and artificial sweeteners may be added to the puree to adjust the sugar-to-acid ratio for optimum flavor. However, adding these materials at this point, that is, before drying, reduces the production capacity of the double-drum dryer. If the flake product is to be used in reprocessing or for institutional use, it may be more desirable to dry mix these additives to the dry flakes or to add them after the flakes have been rehydrated back to the peach puree. If the product is to be sold directly on the retail market, it probably would be most desirable to incorporate the additives with the puree before drying. The answer to this question will eventually have to be decided by the economics of the operation and the desires of the consumers.

One problem common to the dehydration of high-sugar content materials on a double-drum dryer is that of effecting release of the dry sheet from the doctor blade. To overcome this problem, release agents are added to the puree before feeding to the dryer, to facilitate the mechanical handling of the dry peach solids. With the aid of release agents, it is possible to obtain a continuous light yellow colored sheet of dried peaches discharging from the doctor blade.

Two additives that successfully promoted the efficient release of a continuous dry sheet from the dryer were an acetylated monoglyceride (myverol 18-00) and carboxymethyl cellulose. These materials are blended into the peach puree before drying. The amount of release agent required depends upon the sugar content of the puree. It is noted that 0.5 percent myverol on a solids basis was required to obtain a continuous sheet for the 9.6° Brix puree. For the 16° Brix puree a myverol concentration of 1.0 percent was necessary. With the CMC a concentration of 0.5 percent was required for the 16° Brix puree and a concentration of 1.6 percent for the 24° Brix puree.

The quantity of pulp had an effect on the release in the formation of a continuous sheet on the dryer. Puree which had the pulp removed such as that processed through a finisher for use in a drink was more difficult to handle on a dryer. Adding an excess of peach pulp to the puree greatly improved the formation of a continuous sheet. The pulp alone was not sufficient to effect efficient release and good sheet formation. It reduced the amount of release agents required. If the flake process is run in conjunction with the drink process, excess pulp from the drink line can be added to the puree to be flaked.

Drying conditions. A good dehydrated peach flake with 3- to 4-percent residual moisture was produced from the 9.6° Brix puree using a double-drum dryer with 50 p.s.i.g. steam pressure in the drums, 0.006 in. spacing between drums, and 9.5 seconds retention time. A drying rate of 6.7 lb. of water per hour per square foot of drum surface was obtained with these drying conditions. It was necessary to increase the dryer retention time to 17 seconds. A drying rate of 5.3 lb. of water per square foot was obtained. The decrease in drying rate with an increase in the sugar content of the puree is due to an increase in the resistance to heat and mass transfer of the film of puree adhered to the drum surface. The dryer operating conditions are not considered optimum, and further work to establish the optimum conditions is contemplated.

Chrome-plated drums are required to produce a light colored peach flake product. In some of our earlier work dehydration of peaches was tried on a double-drum dryer which had cast iron drums. The flakes produced had a very poor color--a grayish green. This is believed due to the reaction of the

iron drums with components of the peach puree.

Takeoff rolls were used to remove the dry sheet from the dryer. The dry sheet is very hydroscopic, therefore, it is necessary to blow cool dehumidified air onto the sheet as it comes off the dryer. It is desirable to keep the flakes in an atmosphere of dry air until they are packaged. In this study, air at 60°F. and 10 percent relative humidity was sufficient but is not necessarily considered optimum.

Flaking. A coconut grinder was used to break up the pieces of dried flakes. The grinding action is attained by two multitooth rolls turning at different speeds. Blowing the humidified air to the flaker helps prevent sticking.

Packaging. The peach flakes were packaged in metal cans in both air and nitrogen atmospheres, and storage studies are currently under way. It is desirable in future work to include the evaluation of other methods and materials for packaging, for example, flexible packages and glass jars.

Product evaluation. The color and texture of the reconstituted flake product are comparable to that of the starting puree. An evaluation of the flavor by a trained taste panel indicated that the reconstituted product had lost some of the original flavor. However, it was the general consensus of the taste panel that a drink prepared from the peach flakes could not be distinguished from one prepared from the fresh peach puree unless tasted at the same time. The odor of the two products was slightly different.

The reconstitution properties of the flakes are considered to be excellent. The rate of dehydration depends upon the thickness of the dried sheet which is, in turn, controlled by the speed of the takeoff rolls on the dryer. The sheet thickness also affects the bulk density of the flakes. Increasing the speed of the takeoff rolls stretches the dry sheet and makes it thinner. This improves the rate of rehydration, but at the same time reduces the bulk density. Flakes which reconstitute instantly, less than 60 seconds in cold water, have been produced with bulk densities between 25 and 35 lbs. per cubic foot.

Tests are currently under way to determine the stability of the peach flakes when stored at different temperatures for a year or more. Also, recipes for the use of peach flakes in bakery products, drinks, jams, ice cream, and other products are being formulated.

DRY-BLANCH-DRY PROCESS FOR IMPROVED DRIED FRUIT

(SUMMARY)

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A new method was developed for producing dried fruit. It has been named "DBD" after the sequence of operations used: dry-blanch-dry. Apricots, peaches, pears, raisins (both dark and golden types), and apples have been dehydrated experimentally in this way. Dehydrated apples and raisins were made successfully without sulfur. Products had excellent flavor and color. Some resembled their sun-dried counterparts. In addition to producing superior products, the method reduces product losses and relieves sanitation problems encountered in sun-drying operations.

SEVENTH SESSION

PANEL DISCUSSION: "THE FUTURE OF THE PEACH INDUSTRY"

Chairman, B. Dyer, Georgia State Department of Agriculture

The moderator of this panel discussion was to be Phil Campbell. He called and asked me to represent him because he was going to be tied up and would not be able to be here this afternoon.

The topic we have to discuss is "The Future of the Peach Industry." I am not sure what the future of the peach industry is going to be, but I do know there have been some drastic changes made in the last few years.

This past Sunday morning, at my house, we had peach juice to start breakfast off. Peach juice certainly wasn't available a year or two ago. Then, we had cereal but we had fresh peach slices on the cereal. Now, the fresh peach slices came out of a jar that was prepared last summer during peach season and had been in my refrigerator since that time. They were delicious. They were, if not as good, almost as good as they would have been had it been the middle of peach season and we had fixed the peaches and served them fresh that morning. I think that is something that none of us dreamed would happen, certainly not that quick, a few years back.

I believe the future of the peach industry looks a lot different from what it did. Personally, I think it looks brighter. Of course, it is mighty easy for me to sit on the sideline and not have any investment involved in it and say it looks real bright. I do believe that with these new products coming our to help take care of the market situation during the season when we have too many peaches to market at a profitable price along with promotion programs that are being developed, the outlook is going to be real good.

Now, I am delighted to have the privilege this afternoon to introduce to you our panel who will take this subject here and discuss it.

THE BANKER'S POINT OF VIEW

by
C. E. Moore
The Citizens Bank, Fort Valley, Ga.

(No copy of this paper is available for publication)

THE GROWER'S POINT OF VIEW

by
R. L. Dickey
Musella, Ga.

(No copy of this paper is available for publication)

THE PROCESSOR'S POINT OF VIEW

by
W. P. Rawl
Rawl & Sons, Gilbert, S. C.

(No copy of this paper is available for publication)

CONSUMER'S POINT OF VIEW

by
G. Hartley
The Atlanta Journal, Atlanta, Ga.

My head has just been spinning with all the wonderful things I heard here the past few days, and I hardly know whether I am swinging on a microwave or floating on a peach display or been reduced to a milogram.

But you are looking at a person who's grown up with the industry, and I mean really grown up with it. I grew up in Georgia. I grew up in the peach orchards, and packed peaches, and enjoyed peaches, and I grew up on the Atlanta Journal. I have been there 30 years, but, of course, they no longer allow you to leave kindergarten and go to work.

I think you people know your problems. You just need someone to keep pounding it into you, so far as the consumer is concerned. I think that I know the consumer pretty well, being one myself and listening to hundreds of them by telephone and by correspondence every day.

There are times you want to wring their necks, but most of the time you love them, and most of the time they really bring you some good information as well as wanting you to give them information.

Now, I am intrigued as all women or consumers will be, with the variety of products that the peach industry has to offer. I am known for stating facts very frankly, and I am going to tell you very frankly the way I feel about products that go onto the market, and I want you to understand that I am very fond of peaches.

In the first place, and I think you know this, you must appeal to the eye. They must be attractive. You know that and you are doing that to the best of your ability. I think there are some things that can be done to improve them. They must be available, they must be where the consumer can see them. They must be displayed properly, because even though you are an impulse buyer, you don't impulsively buy something unless you can see it. So it must be displayed attractively and where the consumer can easily pick it up. It should be competitive pricewise to any other product that the consumer has been buying that might be used in that same capacity.

These are three of the first things that I think we have to remember. You have a convenience product and this is great. This is the age in which you are living. Women want the things that are easy, they want the things also that appeal to their taste and appeal to their families and that they can always find available when they want it. It must taste good, it must look good, it must be available. The variety that we do offer today is really great, and I think that probably we will have more and more variety.

But I want to tell you another thing. Unless you tell a woman how to use these things and how to use the variety, and you keep telling her day after day, week after week, and month after month, she won't buy it again. She won't continue to buy it. She forgets. She is just like all of us. You have to tell us, you have to pound us, you have to see it.

They (the consumers) are sort of like children too, you know. I have heard children so often come running in saying, "Mama, what can I do now?" And mama has to tell them something else. That is the way they do. To me they call and say, "What can I do with so and so?" So we have to know, you have to develop uses for them. It is not enough to develop a good product. You have to develop variety, and you have to make this available to the consumer, so that she will buy more of the product and go back next week and next week and not do the same old thing over and over; not take it as a drink, not make it into a pie, not make it into punch, but give her variety, because we know until you make a resale, you have never sold a product.

We have a tendency to remember that we don't like a product; we don't go back and buy it, and therefore you can't afford to miss on your first sale.

Now, I have told you the same thing that the others have told you. You said it yourself. But these are just down-to-earth, true facts that you can go home and ask your wife about or ask your neighbor's wife or anyone you like. These are what the consumer wants. She wants it available, she wants it attractive, she wants it to taste good, she wants it to be appealing, and she wants to know "how I can use it, and I don't want to pay more for it than something that I have been using in a similar manner."

I think you are doing a great job, believe me. We certainly hope to hear more from you and to do more in the promotion of this.

Take the Florida citrus people. You can't live without Vitamin C, so far as they are concerned. What do we have in the peach, just what do we have that you can't live without? Promote it. Promote it every day in the year, and you are going to sell more peaches than you can raise and more peaches than you can process. I hope you do.

SUMMATION OF PANEL DISCUSSION

by

Chairman, J. G. Woodroof, Georgia Experiment Station, Experiment

I think we all agree that the discussion this afternoon was a high point in this Conference. This is a point that we have been working up for 2 days. Everything that's been said up until this time has been in an effort to get the grower, the processor, the banker, and the consumer to sit at our conference table and discuss these problems.

I have been familiar with the peach industry for more than 40 years. I used to pick peaches. I have done practically every job in a peach orchard. We used to grow peaches when I was a boy. I have never seen cooperation to this extent before. We have had here this afternoon a meeting of minds, which I think is what we tried to do.

I think these have been masterful presentations. They will be printed and I think many of them will bear reading over and over again, particularly what Mr. Moore said. I think what Mr. Moore said can be summarized in one statement, "New doors have been opened to the peach industry." Mr. Dickey said a grower must be optimistic. That is pretty hard for a grower to be sometimes. But I can say Mr. Dickey tries to be optimistic.

Mr. Rawl said you must get the right quantity and right quality at the right time. That is the heart of the matter to the processor. He elaborated by saying you can't let your plant lay idle half or three-fourths of the year and operate it overtime for the other 3 months. It just doesn't work.

Miss Grace Hartley says, "You know what your problem is, all we need is to do something about it." In doing this, I think while we are sitting around the table, that we could make up our minds and resolve to cooperate. All of us could kind of give a little. We can't be too arbitrary about what we want.

The grower will probably have to give a little. The processor will probably have to give a little. The housewife may want to give a little. I can't speak for the banker.

I think the whole thing could be summarized by saying we have to band ourselves together and go forward which is the summation of what Mr. Dickey said.

Now, we have spoken here of the grower, the processor, the banker, and the housewife getting together; and I think it is most fortunate that Georgia and South Carolina growers have announced that they are getting together. Maybe we are all in a mood to give a little bit. I don't want to say too much because it is anticlimax to the wonderful discussions that have been given here.

Of all the good points about this Conference, there was one thing I feel very keen about, that is the fact that we didn't have a chance for everybody that we would like to hear speak to express themselves. We have several representatives here from California, some from Washington and various other places, from whom we would like some kind of an expression.

We are not going to let the time get away without having a few words from Miss Lora Stone, representing the National Peach Council. Lora, just tell us what you want--not over 5 minutes.

COMMENTS

by
Miss Lora Stone

This has been a beautiful meeting. It's been a really magnificent thing, from the standpoint of the entire industry. I am very proud that the Peach State has been responsible for doing it. When anything looks as if it's been easily done, and this meeting does, it means everybody has been working like heck.

You all know so much more than I do. I know a lot of some things, you all know so much more than I do about so many things. I am up to here with new thoughts and new knowledge.

I don't know what else to say except that it is wonderful. We heard some talk about South Carolina and Georgia getting together on their mutual problems, and I think this in itself is a great land mark if this can be accomplished.

The thing that we hope, of course, is that it will be accomplished under the great umbrella that belongs to the National Peach Council. We thank you so much for letting us be a sponsor of this event. I wish I could have visited with each and every one of you.

EIGHTH SESSION: PANEL DISCUSSION

OPPORTUNITIES FOR THE PEACH INDUSTRY

Chairman, B. H. Wojcik, Southern Utilization Research and Development Division

USDA RESEARCH ON PROCESSED FRUIT PRODUCTS

by
F. P. Mehrlich, U. S. Army Natick Laboratories, Natick, Mass.

I am happy to have an opportunity to be here and talk with you. I am particularly happy that I am able to give support to Dr. Woodroof because for 10 years, he's been very generous in his support of our programs. His contributions have gone beyond the borders of Georgia, are well known around the world, and have had great impact upon our military stance.

I am a reconverted pineapple man. I spent my youth in Hawaii. I have grown pineapples and processed them. I have weathered the storms that the industry there was forced to endure. I went through the great depression of the late twenties and the early thirties. I think I saw destitution and deficit, as was faced by many industries of that time, turned into great profit and advantage through corroborative endeavor.

I think it might be exemplary for those of you who may face similar problems now or in the future to look into the means that were used by the Hawaiian pineapple planters and processors to become the Nation's greatest, I think, in point of application of technical capability and financial resourcefulness.

I have grown food in many parts of the world. I have been on every continent. I was associated with Rockefeller Enterprises for nearly 10 years before taking my present position. We produced food at the basic level, upgraded it, and distributed it.

I came to the Army 8 years ago in an effort to perform a public service, to use to advantage what 35 years of industrial experience had taught. No one knows enough to be

entirely adequate in the position that I now occupy.

The talk I will give represents a change of pace in a degree from what you have heard. I am going to talk about the welfare of your sons, your nephews, and the boy next door, because what I talk about now is not academic. What I am talking about now is actual.

I have been in Vietnam twice. I know a number of their problems. I know what the conditions are and I know firsthand what the challenges are.

It is a policy of the Department of Defense that all of its troops be fed the best food that is available anywhere. In general, a very small percentage of troops ever fight in the type conflict that hits the headlines. Most of the people are preparing for the great day; they are supporting those who are in actual conflict. That group of people, the backup, the great percentage of the total, eat what we call an "A" ration, and an "A" ration is the same thing that you buy at the store, or nearly so. It is comprised of fresh fruits and vegetables and fresh meats which are delivered by the Navy to Vietnam where the vessels stand in the stream. The foods are then carried by helicopter to the units where they are prepared and consumed.

There are other situations, however, where fresh foods cannot be made available, and where reliance must be placed more on processed foods; and such foods for the vast majority of people are the "B" ration.

The "B" ration in the past has been almost completely tinned. It is comprised of 105 different canned items. Not knowing what your background and interest was before I came, I thought I would show you a number of the kinds of things we are doing. I can draw certain lessons from them. I can give you certain common denominators; I can give you a picture of what we see in our future; and our future, of course, is of great concern to you because the military, even in peacetime, if we have experienced such times in my life span, spends a billion dollars a year on subsistence. The Armed Forces are the largest consumers of groceries in the United States, and, I believe, in the world.

I will talk about combat rations; about the new generation of combat rations, the type that are just now being tested in Vietnam to supersede the World War II and Korean types.

I have the most interesting job there is. I am certain of that because no 2 days are the same. Not only do we support the Army, the Navy, the Air Force, and the Marine Corps, but we support NASA, Civil Defense, and we have our finger in almost every pie that is prepared for organized Federal groups.

We write the specifications for procurement of all foods for the military. We have the responsibility for writing over 500 of these. In addition, we collaborate with other Government departments and agencies to write specifications so that we can put into them the particular points that need to be emphasized to make the products useful to the military.

I have some slides to show you. This presentation may be something like the story you would get if you thumbed through a picture book that you'd pick up at the barber's--it will take about that period of time. I could discourse at length on any one of the subjects. What I have tried to do is to give you a bird's-eye view. It probably is a blurred one at that--of the many, many areas that we are working in; the new kinds of things under development; the changes that are going to occur. I might say that the objective I will point to will be peaches on the moon! I will show you that we are helping the astronauts get there.

This first slide concerns military foods of World War II vintage. In the upper left-hand corner is a picture of the "B" ration taken at Leyte in the Philippines during World War II. It took a whole "army" of people to figure out what was aboard the barge and to move it to the classification centers, to "break it down," to reissue it and to take it forward to the troops where it was used under prevailing wartime conditions.

In the foreseeable future, there will be no time for the Army to be used in this way. We have, therefore, conceived a lightweight,

compact, efficient, preprepared group of meals that will be factory assembled, amendable to be flown directly from the factory on the mainland of the United States to the very area where they would be consumed, even to the regimental level. The new ration concept is shown in the lower right-hand corner of this slide. We say "the future," but "the future" is now upon us.

When I showed one of my friends the picture you now see, he said "What the devil does that show?"

Well, it looks a lot different than a box of tin cans! Actually it is the paper and "cardboard" packaging, containing dehydrated foods. These are the kinds of foods that will supersede the canned foods of the past.

Here is the 25-man, uncooked meal. It is shipped in 25-man modules containing all the food required for 25 men for one meal, and on the average it weighs less than 20 pounds, including the boxing around it.

These foods will last for 2 years at 70°F., without refrigeration. They are uncooked in the sense that they have to be cooked before serving. Accordingly, cookstoves and trained cooks are needed to use it in the forward areas. The weight of such a ration has been reduced by more than half, and the logistics have been simplified no end. Any box that one takes has food for 25 men except the bread and bakery items which are to be supplied from instant bread mixes and instant cake mixes through the employment of newly engineered mobile bakeries.

There will be no tin cans in the combat feeding system. The new containers are lined with laminates of plastic and aluminum. They can be thrown in the surf. They can be delivered free-fall from aircraft without the use of parachutes, and over 80 percent thereof will be usable if delivered that way.

This is the quick serve meal, the 6-man precooked meal for small detachments. We have field tested over a hundred thousand of these. There are 21 meals, enough for a 7-day cycle. Each meal supplies 1200 calories of food.

A can of product is seen in the middle-left-hand side of this picture, but we now have eliminated the need for that. It contained bread. We have learned how to bake rolls and cake in plastic containers. The large tin can or aluminum can at the top protects the ration against rodents and insects and it becomes a vessel in which the water is heated that is used to reconstitute the food. A meal can be prepared in no longer than 20 minutes after boiling water is available.

Since we have these prototypes available, we have gradually improved the rate of dehydration of many of the foods, so it is now possible to prepare many of the components in less than 5 minutes. This is very important for the situations that confront our men in Vietnam; makes it apparent that speed of preparation sometimes makes the difference between being able to eat and not being able to eat a meal.

An expendable heater accompanies each of these meals. This gives you an idea of what is coming; tin cans have no place in the future combat meals. The new foods are packaged in such a way as to prevent personal injury; in aerial descent cans weigh far too much. We have saved more than 50 percent of the weight of military foods just by eliminating the water: We use freeze-drying or air-drying as may be relevant to the particular products involved. We have engineered over a hundred new kinds of foods to come up with this series of meals.

A few freeze-dried foods will be shown in the next slides.

Here is freeze drying of beefsteaks. We need the kind of beefsteak that will keep for 2 years without refrigeration! People haven't seen very many of those up to the present time, but here are some!

By freeze drying beefsteaks or other meat and fish items, we are able to keep them without refrigeration, even under conditions that prevail in Vietnam, for many months. They are light in weight because at least 50 percent of the weight of beef is the water that we take out of it.

Steps of the process were told to you by Dr. Hoover this morning. You first freeze the product, then you place it in a chamber where you draw a very high vacuum so as to induce sublimation. The water that is then in ice crystal form passes off in the gaseous

state, and there is no water phase formed. If there is, it deteriorates the food.

We freeze the beefsteaks at about negative 40°F. in a blast freezer, although it can be done in other ways. This requires a few minutes to accomplish. Here you see beefsteaks being loaded into the freezer.

You now see the frozen beefsteaks being loaded into the vacuum chamber. Dr. Hoover this morning spoke about using R. F. energy to aid rapid sublimation in freeze drying. This is a very substantial advancement in the art and something badly needed. I congratulate him on the excellent work he has done.

We have developed other means that may not be as effective in regulating temperature inputs, but even these innovations have made the difference between being able to afford such foods in the civilian economy and not being able to afford them. The price is down to about 10 cents a pound of water removed today. In certain special applications, it goes as low as a cent and a half.

The drying time required initially per cycle was as long as 30 hours. It is possible today to accomplish as much in no more than 4-1/2 hours. Indeed, it is possible to do it in not more than 2 hours in special applications.

In this slide is a type of product that the boys will see: On the left is the dehydrated steak which I say will hold up for months without refrigeration. The steak in the middle is rehydrated by plunging the dried steak, which has the texture of a blotter, into warm or hot water for a period not to exceed 20 minutes. The meat reconstitutes reasonably well, not as well as we hoped it would. And on the right, you see what the broiled steak looks like. It is good, appetizing, nutritious, and clean.

Now, if you will think back to World War II meat rations, especially combat meal types, you will recall that it often took a label on the can to let one know what was supposed to be in it. When you opened the can you were often certain the man had mislabeled it! Here, you can even tell what the product is without a label!

When I was in Hawaii during World War II, I often asked GI's that I would pick up along the roadside what they thought of the local girls or what they thought of the dehydrated eggs. The answer was the same in each case: Terrible!

The dehydrated eggs had a greenish appearance and a rather unsavory aroma. We accordingly looked upon the development of breakfast items as an especial challenge:

We have "come up with" freeze-dried eggs scrambled, capable of being kept for many, many months; the requirements again is a shelf life of 2 years without refrigeration. The product is very acceptable. We understand that this product is so well thought of that the poultry breeders especially in the northeast area of the United States are looking for chickens who can lay freeze dried, scrambled eggs. I don't know how fast they will be able to equal that in Georgia.

Here we see food that is characteristic of the Gulf area. It is possible to dehydrate shrimp and to reconstitute them instantly merely by dunking them in water for a short time. You count to not more than 30 or 40 seconds and the shrimp are reconstituted. Much of the fresh, "brittle" texture is intact.

Such a shrimp product is excellent in appearance and in flavor and will keep for a long time without refrigeration. It is one of the few freeze-dried commodities that is on the market. The United Fruit and Food Corporation has a plant in Louisiana producing these in industrial container sizes for hotel and club use.

Here we have spinach and that is better spinach than my mother was ever able to prepare at home for us. It doesn't even have sand in it and it reconstitutes instantly.

I was told this was a peach conference and being an old pineapple man, it was hard to work any peaches into my talk. But I did the best I could. I have a compote here that has peaches in it. The compote is freeze dried and you can see that the texture and color of the product is quite acceptable.

The common denominators of all of our effort in the combat food area to reduce weight, reduce size, improve ease of preparation, and to improve ease of supply. One

can take peas and compress them so that "blocks" are formed out of them. And as a matter of fact, we have compressed many, many types of foods. Voids are eliminated in that way. Peas have a profound "shape memory." When the block of compressed peas is placed in a dish of water, they rehydrate almost instantly--within a period of 10 to 15 minutes, and they look like Chinese flowers opening.

These types of compressed bars have been used in Special Forces' rations now being tested in Vietnam. This technique also is used in preparing palatable foods of minimum cube for support of the space program. When many foods were compressed we found that their size could be reduced quite substantially. As a matter of fact, we squeezed some experimental foods to the point where nobody could bite through them. We thought that was going too far, so some of our chaps said, "The way to get around that is to make a miniature Dagwood sandwich." Let's make the foods in sheets and put them in a book-like form so a fellow can thumb through and select his favorite from among them. Some are pliable and others can be brittle. If you put them together, you can bite through "the combination."

To show you an array of some such potential foods, we have here maple syrup, coffee, cream and sugar, honey, and shrimp sauce in sheet form. We actually have made up flavor booklets one can use. This is another approach to the development of novel foods which may have great appeal in special situations.

Now, I am going to talk very, very briefly about the irradiation of foods. Your government has spent many millions of dollars in developing technology of great value not only to the military but as well as in the civil community.

I wish that this were ready now so that we could get large cuts of irradiated meat over to Vietnam, for in many of the areas it has been impossible to provide adequate refrigeration.

This slide shows the cobalt 60 source at Natick Laboratories. We have more than 1 million curies of cobalt here. It is the largest source in the world. The cobalt is in slugs, and the slugs are arranged in rods about a yard long. There are 192 of these. The entire source is under 25 feet of deironized water, which acts as a moderator.

When food is to be irradiated, to preserve it, the source is raised up out of the water by remote control. The packages of food are moved between the two ranks of cobalt containing rods. The cobalt emits gamma rays similar to high energy X-rays. They penetrate the package, the container, and the food and kill microorganisms therein.

I now wish to show you some of the kinds of products that we have been able to achieve. They not only are entirely wholesome but they are very delicious.

Here you will see an irradiated pork loin, and in the upper left-hand corner is sweet-sour pork prepared from it. A roast of pork is shown at the bottom of the slide. It is possible to maintain pork without refrigeration after it has been irradiated to 4.5 megarad for a period of at least 2 years. This pork had a shelf domicile of about that period of time before it was prepared for consumption.

Here is a whole meal in which almost every commodity shown has been irradiated. At the bottom is a tasty beefsteak that has been irradiated.

One of the toughest problems we had to lick was the irradiation of beef. Some commodities seemed to be destined to be irradiated and others God made very difficult for us to process in this way. Beef was the real "stinker" of them all. When I say stinker, I mean it. The off-flavor and off-odor developed through the high energy irradiation of beef was described as "wet dog." It took a long stick to poke it down your throat and a stone to hold it down after you ate it if you could get it past your nose.

Our staff following leads developed by the British at Cambridge have found means for consistently producing beef of excellent quality, equal I believe to the best that you have ever eaten. It has no detectable off-odor or flavor. This is done by irradiating at temperatures approximating those of liquid nitrogen, -320°F.

The potato shown has been irradiated at between 10,000 and 15,000 rads to prevent sprouting in storage. We have been working with potatoes for many months. The Food and Drug Administration has approved use of this process for general consumer adaptation.

Peaches were irradiated. I wouldn't want to say a lot more than that. I think they look good but I thought they tasted awful. Peach appears to be one of the commodities that is not easily processed to sterilizing doses by irradiation. I wouldn't say that it can't be done but I would say those that I have seen treated that way do not look very promising.

The Atomic Energy Commission now works on low dose irradiation which has application to the consumer markets. The laboratories which I direct in contrast are responsible for high dose rates, the sterilizing treatment of commodities essentially for the military. We would prefer to have dehydrated peaches. Freeze-dried peaches are magnificent. Shrimp shown on this slide, as a cocktail, is amenable to irradiation preservation.

There is a bread roll in the upper left-hand corner of this picture. It was made from flour that received about 150,000 rads of irradiation to prevent the development of insects in it. The coffee shown--I suppose we didn't irradiate! I guess nobody thought of doing that.

This gives you an idea of the versatility of the commodities with which we work and the delicious types of entirely safe meals that can be prepared "free from bugs." In addition to those shown, we have had research and development responsibility for all of the foods in support of NASA and those used by the Air Force in simulated flights or in actual flights.

You may have read in the papers that various corporations have made contributions to NASA food availability and indeed they have. The actual components that have "gone up" in most cases have come out of industrial laboratories. We have done the underlying development work in our laboratories.

In many instances industrial laboratories have made important inputs. Here is a type of meal used during the GT-3 flight. It shows beef and gravy dehydrated, and additionally some bite-size pieces of food are shown. Another example of our work is a meal that "went up" during the last flight, GT-7; it is the type of thing the fellows ate while they whirled around the earth, ample to go to the moon and to explore on the moon and to return to earth. Included in this meal are such dehydrated items as beef, potatoes, orange juice, toasted bread cubes, and ham-and-egg bites.

Approximately 100 new types of foods were developed in support of space missions to date, but in the time available I can't show you very many of these. I would be glad to discuss with you at another time any matters relating to our space mission.

Now, for the individual soldier who can't eat with his fellows during the lunch hour, we have prepared the individual meal ready to eat. And we have had to get rid of the tin cans as noted heretofore and substitute flexible packages for these.

For the Special Forces we also use this approach: Here are laminates of plastic and aluminum which replace cans. Actually I might call these "flexible cans." We could call the process "flex canning." We use hot packs and retort cooking just as is used in the retort cooking of cans of similar foods.

I don't believe there are any fruits shown in this, but the first commodities that we used in developing this new procedure were fruits because they are easier to sterilize or to get commercially "sterile."

At the bottom of the slide are packages of chicken a la king, green beans, dried beans, and baked beans. This approach reduces the weight of the container to 50 percent of that of tin cans which heretofore were employed. This is a whole new approach, and I think we will see many kinds of convenience types of foods on grocery shelves in the near future in packages of this general sort, because a grocer can put more food in a cubic foot or space on a shelf in this form than he can in cylindrical cans.

Here is the first kosher ham in captivity! Now, this ham never saw a pig. It is

made out of spun soybean fiber. The color is derived from United States certified food coloring. It has been infiltrated with fatty lipid materials; spices and flavors of various sorts have been added. Where we have served this type of product at cocktail parties and to panels, they have thought that it was derived from meat. I think it would be possible to use peanut protein in this same way. It is indicative of another new approach to the better utilization of agricultural commodities.

Now, I am sure that the peach growers could, of course, improve the quality of many of these foods by adding a few peaches thereto! This completes the showing of my pictures and I will be glad to try to answer questions if time is available. Thank you very much.

[The slides referred to were not available for publication in these proceedings]

GOVERNMENT-INDUSTRY COOPERATION

by
J. E. Simpson
Product and Process Evaluation
Agricultural Research Service, USDA, Washington, D. C.

I am with the Utilization Research and Development group in the Agricultural Research Service. We have been in the business, since about 1940, of broadening the base for agricultural commodities by developing new products and processes, a segment of the type of work you have been hearing in the last 2 days on peach products.

We have worked on a lot of different things as you well know. In the beginning, our work, in order to accelerate the broadening of the base, has naturally gyrated toward work with larger and larger industries and larger corporations, because once they adopted a new process or a new product that we have made or that we have helped improve, then the scale of operation with them would be substantial and therefore the base would expand at a fast pace. Not only that, but they have the technical know-how to quickly pick up where we left off and do the adaptive part of the development and put it more rapidly into a paying proposition in the markets.

However, in the last 3 or 4 years, we have not continued in that direction. But, we have reoriented a part of the program to embrace activities which we call our Rural Aid Development Program. In this, we have turned the objective around a little bit to emphasize working with small communities that may be interested in processing agricultural commodities in that particular area. What we have done in the Rural Aid Development Program is to go out and work with communities and regions in an effort to help them sift ideas that they may have and give them information and appropriate ideas. By jointly discussing and counseling with them, we help them find a project or two in the field of agriculture that would be suitable for their locality.

Now, it has not been our purpose to try to say "no" to something that they have proposed are held dear to their hearts--an idea that may be for 25 years they thought--"If somebody would just do this, thus and so, this would be a fine thing." It may or may not be a good idea, but our purpose has been to go out and help them evaluate these ideas. And if they have an adherence to something that is perhaps not too potentially sound, as we see it, we try to help them find something else on the positive side and not just leave them in a negative situation.

I would like to say of all the processing, for example, that has been discussed at this conference--freezing, drying, canning, irradiation, and other technologies--there are two additional techniques that have not been mentioned. One is the foam-mat drying process. Another one is the explosion-puff-drying process. Those two processes have been developed by two of our regional research laboratories--the Western Division and Eastern Division respectively. These processes are on the threshold of commercialization, much like

some of the processes you have been talking about today.

I would like to cite some examples of cooperation with industry. A substantial part of the Department's utilization research success is attributed to the cooperative work done with the industry. Sometimes the relation is direct and sometimes it is indirect. But it takes this sort of teamwork. It is always the "we" aspect and not the single individual or single group that gets any job done. For example, in the state of Michigan, this has come to light in our rural area development program. Michigan seeks outlets for its dry beans. The Department of Agriculture has a project at Michigan State University at East Lansing to developing these products, we have started generating interest in industry to pick up the newly developed process as early as practical.

An example of the benefits to processing agricultural commodities that might be a little bit closer to your own interest here in the field of fruits and vegetables concerns the State of Washington. The apple industry in that State has problems that quite parallel what you have in the peach industry in Georgia and other peach-raising States.

The Washington apple market has been primarily fresh market. They have always looked upon processed apple products as the stepchild. Apple juice, vinegar, or cider were considered of minor importance. With the recent increased plantings, Washington has more and more thought to processing.

I know Georgia can do the same thing with the peach industry. It can be done if you all pull together. For example, we were able to help a Washington State processor to combine two individual processes that we had developed on apple juice manufacture. Through cooperative efforts we were able to accomplish a successful process in a matter of months rather than years. The resulting new fourfold frozen apple juice concentrate is now going quite well on the market.

You are right on the threshold of putting some peach products on the market. Successful marketing considerations are: (1) What has been done in research and development; (2) The problem of finding the raw material, processing, and distribution. If you leave out any of those things in the planning, you don't have good answers and the venture will fail.

An example of typical problems with a new product is the Washington State fourfold apple juice concentrate. The company added a new product to an existing line, but they have had their problems with this new product. For instance, they didn't realize that they were really competing with themselves in putting the fourfold product on the same shelf with the company's old line single strength juice product. Another problem was the luckless venture of trying to market the fourfold product in areas that have poor quality water supply. The poor water caused the reconstituted juice to have an off-flavor and sometimes poor color. A peach concentrate product could easily have these and more problems.

Let me cite one other example of cooperative efforts. The Office of Economic Opportunity requested us to assist some communities in southeastern North Carolina (a minority group) to find ways that they could extend their food supply throughout the year. What became evident when we went down there was to make an adjustment of the old community canner operation. Serving small groups of two or three families scattered over a three-county area presented transportation problems. So we had to take the canner to them. Right now we are developing a portable cannery unit that can be loaded on a single truck. It may be assembled easily for use on a back porch, in a kitchen, or any place. It will be a complete, self-sustaining unit. It will be self-fired. It takes shortcuts in technology, in ornamental embellishments, and features thought essential in a regular plant.

The cooperative part has been what the equipment manufacturers have done to help us to devise pieces of equipment that could be put together to make a unified process (or processes) that will be suitable for these types of fruits, vegetables, meats, poultry, and often products raised by them proper.

One company here in Georgia has helped us tremendously on this project--the Dixie Cannery Equipment Company in Athens. A. K. Robbins is another contributor; two or three others have been very helpful.

In conclusion let me say this--in formulating a project, be sure that you put all the pieces together simultaneously. Be sure it's got (1) a sound marketing plan; (2) good sources of raw materials; (3) a plant designed to bridge those two conditions. Don't establish a plant that will just make one product; very seldom can you do that and stay in business. Be sure the consumer interests have been represented and their needs met. You have a lot of challenges to establish a peach processing industry, but I think with all the ability you have here, you will have some good answers. We in the U. S. Department of Agriculture will be glad to help in any way possible. Thank you very much.

EXPORT PROSPECTS FOR PEACHES

by
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A close look at the world production scene for peaches leads one to the immediate conclusion that very intense competition lies in the years ahead.

The world production of peaches is climbing rapidly. During the past few years, we have seen production worldwide approach the 5-million-ton mark, almost double the level of the early 1950's.

The almost uninterrupted upward trend world production during the more recent years has been due largely to the growth in Western Europe. Virtually every peach-producing country in that area has increased its production.

Although the United States is still the world's leading producer, Italy is rapidly closing the gap. In 1965, it produced about 62 million bushels, slightly more than two and a half times larger than only 7 years earlier. In 1965, the crop was only 12 million bushels below the U. S. output.

France is another European country which has increased sharply. In the early fifties, it produced slightly less than 7 million bushels. Last year it produced 22 million bushels.

The production of peaches in Western Europe has so far been directed largely to the fresh market. As might be suspected, the supplies in Italy and France have been far in excess of the domestic needs. So, attention has turned increasingly to the export sector.

Both countries have concentrated heavily on the West German market. West Germany is today, by far, the largest importing country in the world, takes about 10 million bushels annually.

Despite acceleration in export activity, it has not been sufficient to dispel the development of some rather serious marketing problems on the home front. The situation has been particularly acute in France. Last year marked the third serious marketing crisis in the last 5 years. The prices were low throughout the season. Storages were filled to capacity and little could be done to alleviate the market gluts which persisted throughout the 1965 marketing season. In order to dramatize their marketing situation to the government, growers gave away boxes of peaches to passing tourists.

With further production increases lying still ahead in Western Europe, we can expect that attention will now turn more and more to the field of processing. Some processing is already carried on in both Italy and France as well as in some of the other more southerly European countries.

Over the past few years, very modern canning facilities have been erected in France, all equipped with the latest type of machinery as well as American know-how. Much the same picture exists in Italy.

Insofar as opportunities for exports are concerned on the fresh market side, I would say that our participation in Europe will be limited much to the period prior to about the

middle of June. It is in about mid-June that both France and Italy start their volume marketings.

The recent reduction in air freight rates effective last January could open up a new avenue for us.

Insofar as exports of processed products are concerned, canned peaches have been by far the largest dollar earner in the processed fruit family.

In 1962 and 1963, we marketed an alltime high of 6.4 million cases into export. This is truly remarkable when we look back to slightly less than 10 years ago, at which time we marketed only about 2 1/2 million cases.

West Germany has been our major market for canned peaches, taking 38 to 44 percent of our total exports in more recent years. Nine European countries plus Canada account for 90 percent or more of our total exports. Though we have been and still continue to be the world's largest exporter of canned peaches, the complexion of the export deal appears to be changing.

In recent seasons, we have noted an increasing number of countries gaining a volume-and-quality status which in turn has generated a closer degree of price competition for the United States.

Two of our biggest competitors at the moment are Australia and South Africa. Both have increased their canned peach packs considerably. Other competitors of lesser, but increasing prominence are Japan, Chile, Argentina, and Spain.

A measure of the intensity of competition we face in world markets is revealed by the amount of production moving into export. Some of the countries I mentioned produce primarily for the export market. They do not look upon the export outlet as a mass of red tape. Rather, they have adopted a well-planned, organized marketing program, and go to great lengths to stay in the world market in order to earn foreign exchange.

These countries are now shipping a high quality product, price competitively, promote aggressively and will, if necessary, sacrifice their local markets in order to fill export orders.

South Africa tops all countries in this field. It ships about 90 percent of its total production into export. Australia ships about 55 percent in the same manner. Because of their increased production, Australia and South Africa, of course, have become very competitive price-wise. In past years, these two countries have marketed heavily in the United Kingdom (U.K.) because of national affinities and tariff preferences.

But in more recent years, because of the lower selling prices of these Southern Hemisphere suppliers, our share of the U.K. market has shrunk considerably. In the 1962 season we commanded about 29 percent of the total U.K. market. In both the two most recent seasons, however, our share has dropped to 7 percent, dropping from a level of 1.4 million cases to about 365,000 cases.

Both Australia and South Africa are now starting to move into other markets, particularly West Germany, Belgium, the Netherlands, and the Scandanavian countries. The volume is still small in these other markets; we can expect an intensification of this drive as their production continues to increase.

Now, from the standpoint of juices, bases, and nectars, there is probably some opportunity in Western Europe. That market is largely untapped at the moment. But, here again we are going to have to fight for it as surpluses start to mount in the nearby producing countries such as Italy and France.

In summary, I hope you will interpret my remarks merely as a description of a competitive picture as we see it. I do not mean to infer that our export role for U.S. peaches either in fresh form or in processed form is a hopeless one. Frankly, I believe much to the contrary.

With further population growth and a rising standard of living, opportunities still exist; but the scene is different than it was 5 to 10 years ago. Competition is much more intense. Hence, we are going to have to work hard to stay in the foreign market.

American ingenuity in the processing and marketing field is a matter of international envy. Our competitors have learned much from us and they have learned well. But now our task is once again in the face of ever-increasing competition to find ways to get into the foreign market, stay with it, grow with it, and, finally, keep at least one step ahead of our competitors.

Remember, if we don't, someone else will. Thank you.

MARKET POTENTIAL FOR NEW AND IMPROVED PEACH PRODUCTS

by
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The food industry, unlike the automobile and some other industries, does not introduce completely new models in the fall or have a so-called model year. If all the "new" food items of the last year were introduced at one time, we would be staggered at the change. For example, it was reported that in 1964 one food firm introduced 50 new items, a soap manufacturer 35 new brands, and a meatpacking company 87 new products.[1/] These, of course, are large companies, but smaller firms are also presenting new products. Add to this an enormous number of redesigned packages and labels and you have some idea of the continuous facelifting that is constantly going on in our retail stores. The food shopper is accustomed to these changes and is demanding many of the changes while others are made by forms seeking to capture a larger share of the market. Hundreds of new ideas are screened each year. Only a few of these actually reach the market. Then one out of three fail in 1 year after reaching the grocery shelf.[2/]

New products that meet the needs of modern food preparation concepts, in convenient form, good quality and appearance, and at a reasonable price when properly presented are the successful ones. Many are developed into multimillion dollar products. Some examples of successful products are instant coffee and tea, cake mixes, instant potato flakes, and freeze-dried products.

What has happened to peaches? Thirty years ago we had fresh peaches, canned, pickled, and dried peaches, peach preserves, and some occasionally had a little peach brandy. We home-canned most of these processed items. Last summer, we had fresh peaches; last week we had available canned peaches, peach preserves; with some difficulty, we found some pickled peaches. I haven't seen dried peaches in the grocery store in so long I have almost forgotten what they were like. I'm sure dietetic peaches are available, but I didn't look for them. What's new in peaches? Last year, freeze-dried peach slices were put in breakfast cereal, and this means a market for a large volume of several hundred thousand bushels a year.

For the past 2 years, encouraging work on peaches has been going on at the Georgia Experiment Station under J. G. Woodroof.[3/] He has been working on peach puree, which when added to equal parts water gives a drink of good color, aroma, and taste. Undiluted, the puree is versatile. It could be used as an ice cream topping, in cakes and pies, or on salads. I passed this product out to about 200 people and asked them what they thought about it. An unusually high percentage of people said they liked it and would buy it if it were available. In the home economics kindergarten at LSU, the children preferred it to grape, tomato, and orange juice usually served them. I understand that Dr. Woodroof had very good results with the product in Atlanta cafeterias and in stores here where it was sold. These were informal tests carried out to get some indication on the acceptance of the product. They are helpful in getting early reactions and in encouraging commercial interest. We need

1/ Adkins, O. M. The Importance of New Products to Food Companies. Food Technology, 19 (10): 50–54. 1965.
2/ Harris, C. M. What Buying Committees Demand. Printers' Ink, 287. (9): 130–132. 1964.
3/ Chairman, Food Science Division, Georgia Experiment Station, Experiment, Ga.

a more highly organized and controlled market test before we can reliably predict volumes that can be sold.

Chilled peach slices is another product of research at the Georgia Station and Clemson University Experiment Station which may have a good potential. This is a real convenience item which may command a premium over other forms of peaches. This product handled and distributed the same way as chilled citrus sections has done well in market tests.

Dried peaches is still another product receiving attention. Judging from the sales volume of snack items, a good dried peach might be a "natural" for such use. Dehydrated peach flakes have also been under study at USDA's Southern Regional Research Laboratory.

There is always room and a need for improved products. Are the products now offered meeting the needs and desires of consumers? We still need to extend the shelf life of fresh peaches. Chilled peach slices are one means of meeting the demand for convenience and to extend shelf life. A waffle-type breakfast food with a fruit center can be put in the toaster for breakfast. Can peaches be used in this new product?

To avoid costly and discouraging failures, each new product concept should be examined and tested for consumer and market acceptance. As rapidly as an acceptable product can be produced, it should be subjected to taste test panels, institutional and household placement tests, and then market tested. These tests eliminate some products, of course, but they provide a sound basis for commercial production.

The Economic Research Service has a program for evaluating the market potential of new and improved products. Early studies of the market potential for instant potato flakes, sevenfold concentrate apple juice, instant sweetpotato flakes, dehydrofrozen apple slices, and other products have made important contributions to their commercial developments. In some other studies of new products, the test marketing indicated poor market potential, and attempts to encourage commercial production for these products were dropped until an improved product was developed. A program such as this requires the cooperation and support of producer groups, processors, and retail stores. We find consumers willing to cooperate in testing new products and in reporting their reaction to new and improved products. Certain new food concepts can be explored in group discussions with homemakers to obtain consumers' reactions to a new product idea long before the product is ready for testing.

The proper evaluation of the market potential for new products can aid the peach industry in expanding old markets and in creating new markets.

WASTE DISPOSAL

by
R. S. Ingols
Georgia Institute of Technology, Atlanta, Ga.

It is a little difficult to be a last speaker on a program on such an unpleasant topic as waste disposal, but it is a phase of industrial life that those of us in Georgia must learn to recognize even though in many areas of the country it has been stressed for many years.

A stream pollution problem develops from peach processing and becomes extremely difficult when the problem was not considered in the choice of the original location of the mill. Very frequently plants which are located near production areas have been placed in a small community where there may or may not be a dilution water (a river or lake) for receiving the waste water from the plant. While the rate of action of bacteria upon the sugars and citric acid (BOD) can be reduced by the strong alkali (the high pH depresses bacterial activity), the high pH of itself is also damaging to fish. Thus, it is necessary to reduce both the sugar content and the pH for compliance with the present water quality control laws. The latest law says that the State owns the water and that industry cannot abuse it.

In order to comply with this situation waste water treatment processes must be provided despite the fact that these units will cost money and we live in a competitive economic system. Thus, in order to comply with the treatment needs, either a city must accept the waste and increase taxes or the manufacturer must bear the increase in cost by increasing the price of the article.

The City of Griffin, for instance, is on a ridge. There is no stream within miles of Griffin that is capable of receiving waste water. Yet, this is an area producing peaches and they are processed here in Griffin. The byproduct waste water has caused nothing but grief from fish kills in a pond fed by a small stream.

The waste water is damaging because the peaches which are frequently peeled with a hot strong lye solution contains sugars and citric acid. I hardly need to discuss lye peeling with this group but it is necessary to tie this to waste water problems from peach processing. The wasted alkali solution is undesirable both from the high pH which inhibits bacteria in stream recovery and from high concentration of sugar and citric acid that are added to this lye peel solution and thus to the waste water from the plant.

The organic matter or bacterial food that enters a stream is capable of suffocating fish because the bacteria can compete readily for the oxygen that is available in the stream. This is called biochemical oxygen demand (BOD) of waste water.

The need for good water in rivers while not contributing to an improved product does increase costs of doing business. I realize that anything that is recommended for waste water treatment simply increases the overhead cost of the product.

But the Water Quality Control authorities in the State are continuously trying to raise the quality of the environment in which we live. This includes the streams which a manufacturer would use for disposing of his waste water. The stream pollution control authorities are trying their best to retain rivers for recreational use.

On the other hand, the Department of Industry and Trade would increase the production of processed foods or processed products, and it is a continual battle between the Water Quality Control Commission and Industry for the development of this State. The State is in the middle of such a decision right now. When a new processing plant is under consideration, its waste water disposal problems should be studied before it is located. Otherwise, there will be many problems in licensing and/or in the cost of waste disposal.

There must be consideration given to stream pollution if large quantities of food are to be processed because there will be wastes that cause damage whether the waste contains the purest of sugar or the foulest smelling fecal matter. Either one of these materials when added to a stream is utilized by bacteria, removes the oxygen and suffocates fish. Fish skills are intolerable, according to our present Water Quality Control authorities.

I wish I could provide you with a quick and easy answer. If the plant is properly located so that space is available for extensive lagoons, costs are not as large as in a location with limited space where mechanical aeration of deep lagoons appears to be the best answer.

Waste water treatment is a very difficult problem, but it must be considered along with air pollution control when the plant is located near population centers.

Air pollution and water pollution or, in other words, environmental control is here with us. As our population expands, the problems of environmental control will become more and more acute and each of us will have to learn to live with this problem.

SUMMARY OF THE CONFERENCE

Chairman, E. Duke, Jr., Georgia Agricultural Commodity Commission for Peaches

Well, I think I have been given about the biggest topic on the program, and I see they didn't limit my time. They just left it open on the end! You can see I can't summarize everything that's been said here in these past 2 days unless I do it in one word. And I think that everybody that's been in on this Conference in the last 2 days has received a challenge in his particular field, to do things in the area of peaches, and it can spread over to other commodities or other things.

We as growers, processors, researchers, see problems we haven't seen before. We see new challenges ahead of us. We see that the door is just beginning to crack open.

We need to attach this problem with new vigor all the time. It is wonderful to have cooperation and the sitting down of people together to aid in carrying forward our mutual interests. A processor can't get along without the producer, the producer can't get along without the grower, and both of us have to have the researcher to tell us what to do.

If we, as growers, can band together to form the nucleus of a spur and the processors to secure new facilities, to secure new funds, to carry out new ideas, to try new things, to let our imagination grow, then we can take on these many ideas that have been sent in here before.

Once again, I will say that the summary of this Conference is a challenge to see new ways of doing things, to imagine new ways of doing things, and to make us have new ways of doing things. And let's stop the peaches we are wasting. Let's give the housewife new ways to eat peaches, new ways to eat other products, and continue to make the American housewife the best fed person in the world.

CLOSING REMARKS
by
B. H. Wojcik
Southern Utilization Research and Development Division

I should like again to thank Dr. Woodroof and his associates for giving the Southern Utilization Research and Development Division an opportunity to co-sponsor this program with him. I would also like to thank my associates who have worked with the staff here in organizing this program.

CLOSING REMARKS
by
J. G. Woodroof
Georgia Experiment Station

I want to say thank you to the sponsors, the Cooperative Extension Service, the Georgia Agricultural Commodity Commission for Peaches, the Peach Council, and the Georgia Canners Association. We thank you for cosponsoring this conference. We thank the National Peach Council and the Economic Development Administration of the U. S. Department of Commerce. We want also to thank the USDA, ARS, Southern Utilization Research and Development Division.

I want to thank each of you that served on the program. You have done a magnificent job. I have been amazed at the seriousness with which you took your assignment. That is not just something you were trying to say and get rid of, it was something you really put sometime on.

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